MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

PLAYGROUND FOR CHILDREN, OAKLAND, CAL.

VOL. XLVI. JUNE, 1914. NO. 6.

Everywhere in human society two principles have been and are at work, principles antagonistic to one another, yet equally essential to the well-being of civil society. These are the principle of Obedience and the principle of Independence—the submission of the individual will to other wills and the assertion of that will against other wills. The reasonable mean between, or an adjustment to one another of these two principles, creates what we call Free or Popular government, in which a relatively large number of individual wills agree to form a collective will of the community, and to obey that will cheerfully because each individual has borne a part in forming it.

—James Bryce.

Published by

Engineering Publishing Co.

INDIANAPOLIS, IND.

New York Office:
1125 World Bldg.
GEO. H. CLINGAN,
Eastern Mgr.

Chicago Office:
438 Marquette Bldg.
E. D. POWELL, Western Mgr.
LUTELLUS SMITH, JR.,
Adv. Rep.

Entered at Postoffice, Indianapolis, as Second-Class Matter.

A. P. Fox, President. **C. C. Brown, Editor.** **C. S. Sale, Gen'l Mgr.**

Subscription Price in U. S. and Possessions, Cuba and Mexico, $2.00. Canada, $2.40. Foreign, $2.75.

Changes of address, subscriptions, remittances and editorial matter should be addressed to MUNICIPAL ENGINEERING, Indianapolis, Ind.

SUBURBAN STREET LIGHTING

VAN NUYS LIGHTING DISTRICT, CALIFORNIA

Two articles from opposite ends of the United States show methods of lighting sparsely settled roads and boulevards in suburban districts where ornamental lighting is an attraction rather than an absolute necessity. The first system is from the neighborhood of Los Angeles, Cal., where a State law provides a method of establishing lighting systems in unincorporated towns, villages and country districts.

THE Van Nuys Highway Lighting District was organized August 10, 1912, under the California act providing for the highway lighting of unincorporated towns and villages and country sections. The Van Nuys District, which is 16 miles long and 8 miles wide, embraces about 52,000 acres in the southwestern part of the San Fernando Valley. It is located fifteen miles northwest of the center of Los Angeles city, and covers all of the 47,500-acre Van Nuys-Lankershim tract, developed during the past three years by the Los Angeles Suburban Homes Company of Los Angeles, the 4,500-acre Encino ranch, owned and operated by the Amestoy Estate Company of Los Angeles, and the townsites of Van Nuys, Owensmouth and Marian.

Most of the lands included are as level as a prairie, with deep rich silt soil and only three years ago were used exclusively for raising grain and pasturing cattle and horses. Today, however, this has been transformed. A double boulevard costing $500,000 built thru the center from one end to the other is parked on both sides 40 feet back with ornamental trees, shrubbery and choice roses. One side of the boulevard is for the exclusive use of automobiles, the other side for teams and trucks. Between the roadways are the tracks of the Pacific Electric Railway, giving communication with Los Angeles.

Along the entire southern part of the district and skirting the foothills, the State of California has about completed a stretch of the State Coast highway, leading from Los Angeles thru Santa Barbara to San Francisco, which is expected to be finished the entire distance in time for the opening of the Panama-Pacific International Exposition in 1915.

At least twenty-five miles more of improved highways have been built within the district besides the two above mentioned main arteries of travel.

Van Nuys, the first town established, was opened February 22, 1911, and is now one of the most flourishing new settlements near Los Angeles.

Owensmouth was opened in the west end of the tract in March, 1912, and is also making phenomenal advancement.

The site of Marian is located on the boulevard, midway between Van Nuys and Owensmouth, and will be opened soon.

It was to light these highways that the Van Nuys Lighting District was organized. It is the most comprehensive in the state, and no such extensive system of ornamental street lighting outside of large cities has ever been undertaken, probably, in the world.

The votes creating the district came from the new settlers. Sixty votes were recorded for and and eighteen against. The small vote was due to the fact that the majority of people living in the tract came from other states and were not elig-

SHERMAN WAY *in the Van Nuys, Cal., rural lighting district. The white area on the extreme right is the driveway parallel with that on the left, the two forming the boulevard, with the electric railway line between, track and pole line being seen in the photograph. The beginning of the planting scheme for beautifying the boulevard is seen parallel with the curbs on both sides of both driveways. The ornamental lamp posts are also seen at regular 660-foot intervals on the outside of each driveway.*

ible to vote on account of not having been in California the required year.

Under the act creating highway lighting districts, the board of county supervisors of the county in which any district is located is ex-officio the board of supervisors of the district.

The supervisors of Los Angeles County have adopted a method of government for lighting districts under their control, whereby a local committee is appointed to pass on and approve all matters pertaining to the district before they are acted upon by their board. The duties of these local committees include recommending extensions and amounts necessary for yearly maintenance, passing on all bills, looking after proper maintenance and providing repairs where not covered by maintenance contracts. The Van Nuys committee is composed of four members, selected from different parts of the district, and meets once a month.

The first lighting undertaken by the district was along Sherman Way, the 16-mile boulevard extending thru the tract. A sum of $75,000 was recommended for this purpose, which was included in the 1912 taxes of the district, and the entire amount was raised in that year.

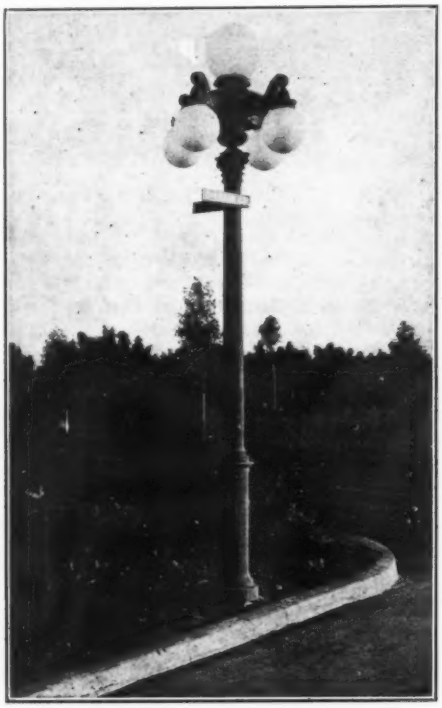
After looking over the various systems of street and highway lighting in Los Angeles and surrounding cities, the committee decided on cast-iron electroliers with three-light clusters for use along the boulevard outside the townsites, one 60-watt lamp upright and two 40-watt lamps pendant. Cast-iron posts were selected on account of their strength and durability. The electroliers were located 330 feet apart staggered, or 660 feet apart on each side of the boulevard, which is about 100 feet wide.

In the three townsites, five-light clusters were used thru the main parts, four electroliers to every street intersection. On these five-light posts, one 60-watt lamp was upright and four 40-watt lamps pendant, and they were placed through the main parts of the towns, four electroliers to every street intersection.

Conduit was used for the secondaries in the three-mile installation east of Van Nuys and in all the townsites. On the other parts of the system the secondaries were carried on the poles of the Southern California Edison Company, except 2¾ miles, from Owensmouth to the State Highway, where the district put in its own pole line and all primary and secondary circuits. This last section is the only place where the district has its own

primary line. The system called for a transformer furnished by the Edison company, to be placed for approximately each mile of installation. These units are controlled by time switches furnished by the district.

The first contracts, for the installation of 253 three-light and 49 five-light electroliers along the boulevard and for one



THE ELECTROLIER *used on Sherman Way, with street signs when on corner of two roadways.*

year's maintenance, were awarded August 7, 1913, and were under three separate heads:

First, the furnishing of the bare electroliers erected on cement bases.

Second, the installation of conduits, wiring, building pole line, furnishing time switches, lamps, 16-inch Alba globes for upright lights, 12-inch Alba globes for pendant lights, and everything necessary to put the system in complete operating order.

Third, maintenance of electroliers on a flat rate per month, which included furnishing electrical energy, painting posts once a year, renewing all broken globes and lamps, cleaning globes and posts once a month, and maintaining system on the following schedule: Three-light posts to burn from dusk to 1 a. m.; five-light posts, the upright to burn all night and the four pendants from dusk to 1:00 o'clock a. m.; all to burn every night in the year.

The contract under head one was awarded to the Llewellyn Iron Works of Los Angeles for the sum of $13,100; under head two, to the Newbery-Bendheim Company of Los Angeles for the sum of $21,188; and under head three to the Southern California Edison Company at the rate of $2.75 per month for the three-light posts and $4 per month for five-light posts.

At the same time the district took over 78 five-light posts and 39 three-light posts which had been installed by the Suburban Homes Company in Van Nuys, Owensmouth and on North Sherman Way at a cost of $14,157.40, and which were included in the maintenance contract with the Southern California Edison Company. The electroliers for this contract and for additional street lighting in the townsites of Van Nuys and Owensmouth were furnished by the Llewellyn Iron Works. The Pacific Underground Construction Company of Los Angeles installed the conduits and wiring.

On September 29, 1913, contracts were awarded under similar terms with the same three companies for two additional five-light posts and four three-light posts, which were found necessary to complete the boulevard lighting. The cost of installation was distributed as follows: Llewellyn Iron Works, $285; Newbery-Bendheim Company, $320.

In the fall of 1913, a further sum of $24,000 was levied to put the electroliers along South Sherman Way, leading from Van Nuys to the State Highway, and along the State Highway to connect with the west end of the system already installed. The total distance covered by this additional lighting is 11 miles, and the work is now under way. When fin-

ished, a continuous 25-mile circuit of paved and lighted highway will be provided.

Contracts for this work, which provide for 188 three-light poles, were awarded October 20, 1913. The Llewellyn Iron Works secured the electroliers and bases for $8,765, and B. F. Kierulff, Jr., & Co. the installation for $11,134.

When all the system now under contract is completed, the Van Nuys Lighting District will have in use 484 three-light posts and 129 five-light posts, which will have cost for installation $69,649.40, with an average cost for each post of $114.

The yearly maintenance cost will be $22,164.

In addition, there are 24 five-light posts in each of the townsites of Van Nuys and Owensmouth, which were installed and are being maintained by the townsite companies, and also several private three-light posts along the boulevard.

With these, the grand total of electroliers in use in the district will be 664. The total distance of highways and streets covered will be 33 miles.

The assessed valuation of the Van Nuys Lighting District for 1913 was $5,869,915, which showed an increase over the preceding year of more than $700,000, mostly due to building improvements. So this enterprising Southern California community believes that highway lighting pays. Further extensions are being considered for the near future, which will include 100 additional electroliers.

SHERMAN WAY *by night in the village of Van Nuys, Cal., four electroliers at each street intersection.*

SUBURBAN STREET LIGHTING

LIGHTING OF NORTH SHORE BOULEVARD, LYNN TO SWAMPSCOTT, MASS.

By G. N. Chamberlin, Engineer Arc Light Department, General Electric Co., Schenectady, N. Y.

This second article, for which we are indebted to the General Electric Review, describes the installation of ornamental luminous arc lamps on a highly improved shore drive in the metropolitan park system of Boston and its suburbs, and compares it with its predecessor, a system of gasoline lamps. Comparison with the installation described in the preceding article will also be of interest.

THE employment of the ornamental luminous arc for the lighting of principal business thoroughfares has been met with such favor that, as a natural consequence, its use is now being rapidly extended to the lesser populated areas. The suitable illumination of public highways has not as a rule been given the careful consideration that it deserves. When such large sums are spent in the building and up-keep of parkways, boulevards and shore drives, it is thoroly in keeping that the lighting units should be of the same high order of excellence.

The following example will clearly illustrate the immense improvement in lighting which can be secured along such highways.

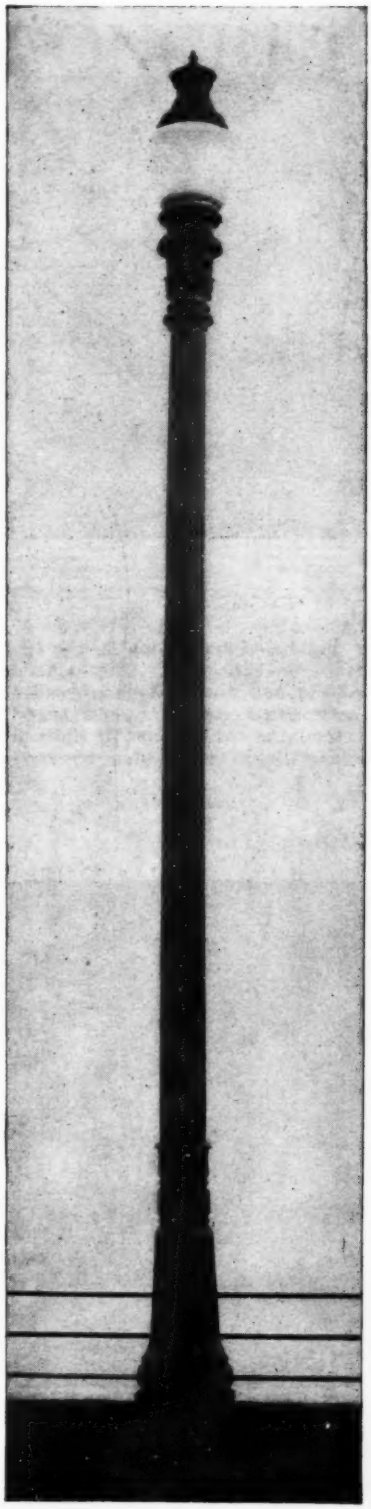
At the expiration of the contract for boulevard lighting, the engineers of the Massachusetts Metropolitan Park Commission, being familiar with the excellent illumination obtained from the luminous arc, approached the Lynn Gas and Electric Company relative to the illumination of that section of the North Shore boulevard from the Bath House, Lynn, to Monument Square, Swampscott, a distance along the ocean front of about two miles. A thoro consideration of the subject resulted in a contract which provided for the installation and maintenance of forty lamps by the Lynn Gas and Electric Company.

The lighting system previously employed consisted of gasoline mantle lamps, two on a pole. The poles were about 12 feet high and the lamps were equipped with large clear globes arranged in the usual manner. The mantles were rated at 32 cp. each, but, under service conditions, some were found to run as low as 15 cp., and a number of tests showed an average of about 25 cp. per mantle. Each lamp contained a small reservoir which held only enough gasoline for one night's burning. The method used in filling these reservoirs is shown in Fig. 1.

The light given by these lamps was, however, thoroly inadequate for either the automobilist or pedestrian. Photometric tests made in the center-line of the street with a Sharp-Miller photometer gave an average of 0.03 foot-candles opposite the lamp and an intensity halfway between the lamps far below the reading limits of the instrument.

The new lamps, which were turned on for the first time Christmas night, 1913, are of the ornamental luminous arc type, operating on a 4.0-ampere rectifier circuit and consuming about 300 watts each. The arc is placed 18 feet from the ground, and the lamps are spaced from 200 to 300 feet apart on the shore side of the boulevard. A light-diffusing globe is used which distributes a well-diffused and

NEW LUMINOUS ARC LAMP *of artistic design, harmonizing with the beautiful boulevard.*



pleasing white light. Fig. 2 shows a complete unit installed. These tall, slender poles with a single globe at the top are in no way conspicuous, but, when attention is directed to them, they are found to be artistic in design, harmonizing perfectly with the beautiful stretch of boulevard maintained by the Commonwealth of Massachusetts.

The work on this installation was started December 3 and completed December 23, underground construction being used. Fig. 3 shows a section of the Shore Drive with the luminous units installed, and the old lighting units will also be seen, not having been removed at the time the photograph was taken.

Fig. 4 is a night view of the roadway and promenade. Photometric tests, made under similar conditions to those with the old gasoline lamps previously mentioned, show for the luminous arcs 0.37 foot-candles in the center of the road opposite the lamps and 0.008 foot-candles halfway between the lamps. This is about twelve times the illumination secured from the gasoline mantle lamps, and it is rather interesting to note that this increased illumination is being furnished at less cost than that of the previous gasoline installation. Altho the roadway presents a dark, poor reflecting surface, the single units are of sufficient intensity to make use of the now generally understood silhouette principle of lighting.

The promenade is of granolithic construction having a better reflecting surface, and shows figures in excellent relief.

A very pleasing sight, since the installation of these arc units, is the white crests of the breakers along the beach. The intrinsic brilliancy of the light source is also noticeably low and does not interfere with the ocean view from the residences on the opposite side of the Shore Drive.

DAY AND NIGHT VIEWS *of the boulevard are shown by the two photographs on this page. The location and handsome and harmonious appearance of the new lamps and posts show best in the day view, and the amount of light and its diffusion are demonstrated by the night view.*

From the results now being obtained, it would seem certain that the ornamental luminous arc lamp can be used as economically and efficiently for this class of work as for the illumination of the more densely populated areas.

REINFORCED CONCRETE TRESTLE

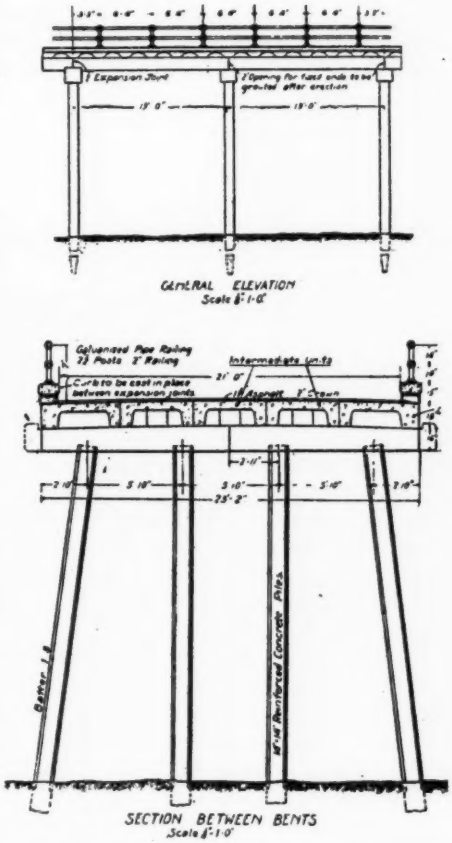
IN CALIFORNIA HIGHWAY

The floods in the Sacramento Valley have long been known as exceptionally violent. The State Highway Department had the experience of the Southern Pacific Railroad in this particular case and seems to have provided ample waterway for the floods passing thru the railroad trestles, with something to spare for a maximum greater than any yet experienced, a contingency which recent experience elsewhere indicates as possible, if not probable.

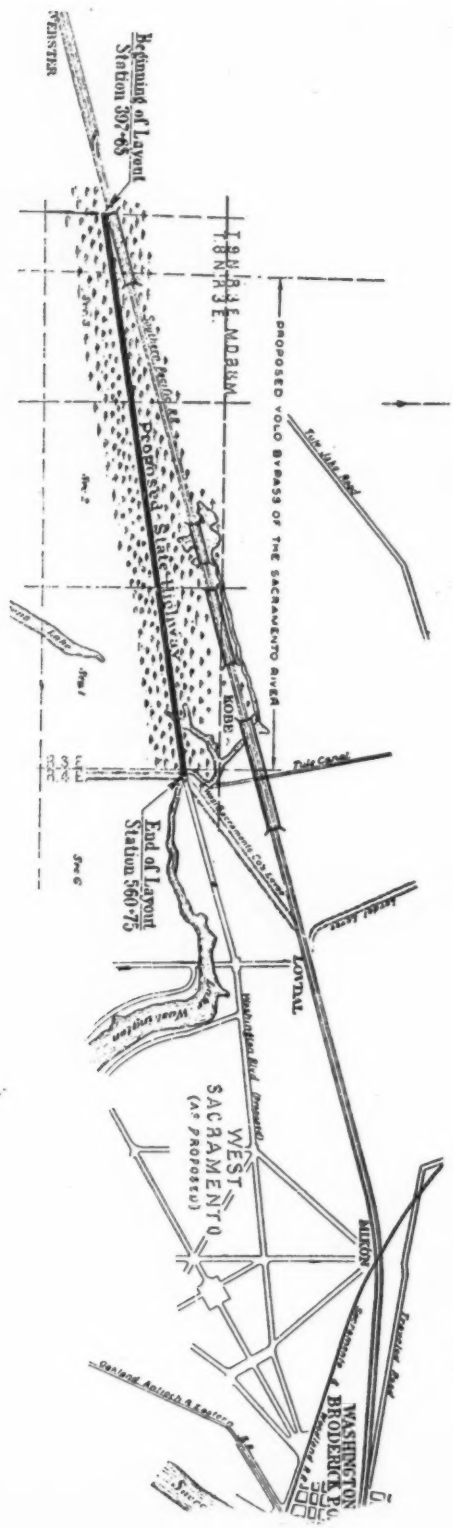
THE Sacramento River in the vicinity of Sacramento, Cal., is subject to frequent overflows, which are occasionally heavy enough to produce very serious results. Sacramento itself is located on the east side of the river in Sacramento County.

When the State Highway Commission planned for the improvement of the highway into Sacramento from the west, passing thro the proposed plat of West Sacramento, in Yolo County, on the west side of the river, it was considered necessary to elevate about three miles of it above the ground across what is called the Yolo by-pass, an overflow channel for the high water in the river.

It will be seen from the plan of the highway that the Southern Pacific Railroad, on the north and upper side of the line of the highway, has several long trestles in its roadbed across this same Yolo by-pass, which together have a length of more than one and one-half miles, and that the levees and the railroad grade force all the water in the by-pass to go thru these railroad trestles before they reach the highway. Nevertheless, it was considered best to leave the entire three miles of the roadway open for the passage of the water, and it is, therefore, carried on trestles with bents 19 feet apart. The clearance between the ground surface and the bottom of the girders carrying the roadway is not less than 15 feet, and in a few places is as much as 28 feet.



ELEVATION OF CONCRETE TRESTLE *in Yolo County, California, highway, above. Section showing concrete pile bents and cross-section of floor system, below.*



PLAN OF STATE HIGHWAY TRESTLE *across Yolo By-pass, just west of Sacramento, Cal. Note Southern Pacific Railroad grade on north or upper side and length of trestles thru it; levee around West Sacramento; and continuation of highway on fill at the west end. A half mile of temporary trestle at the west end gives an opportunity of testing the sufficiency of the openings before filling with earth or replacing with a continuation of the concrete trestle.*

The concrete trestle is 13,851 feet long, starting from the West Sacramento levee at its east end, and a temporary timber trestle extends 2,318 feet farther west, apparently with the intention of filling in this section later with earth or other material.

Four concrete piles are to be driven for each bent, two vertical and two other piles on a batter of 1 in 8, as shown in the sectional drawing. The piles are made of 1:2:4 concrete, 14 inches square at top, with ⅞-inch round rods in the four corners, wound with No. 6 black wire wound spirally with pitch varying from 1 inch at top to 5 inches for all but the upper 2 feet length. The lower 5 feet of each pile is tapered to 6 inches square at the bottom and the corners are chamfered for 25 feet down from the top.

The piles are driven with a 3,000-pound steam hammer by the *Engineering News* formula, and are estimated to average about 32 feet long in place.

The piles are allowed to harden for at least 30 days before driving. Concrete caps are cast in place on top of the piles, being of form and dimensions shown on the drawings, viz: 23 feet long, 2 feet wide, 16 inches deep at ends and 18 inches deep at center. Special forms of caps are provided at expansion joints and lamp-post locations.

The concrete floor units are inverted trough sections as shown in the drawings, the forms of the three intermediate units being slightly different from the two outer units, which carry the wheel guard and railing. The slabs of the floor units are 18 feet 10½ inches long, the outer units 4 feet 10 inches wide and the intermedi-

ate units 4 feet 6 inches wide, thickness 6 inches. The long sides of the channels are 10 inches thick at the bottom and 11 inches at the top, and 12 inches deep, making the total depth of the floor members 18 inches. The ends or short sides of the channels are 8 to 12 inches thick at bottom and 3 inches thick at top. These floor units are cast in the yard and hardened at least 30 days before placing.

The floor units are tied together by bolts and dowels, with special connections at expansion joints, there being a ½-inch expansion joint at every third bent.

The caps and floor units are fully reinforced with ½-inch and ¾-inch rods, stirrups, ties and spacers.

On the outer edges of the outer floor units the wheel guards or curbs are cast in place, doweled into the floor unit, and carrying the pipe rail fastened also by dowels. The curb is 15 inches high and about 12 inches thick, and is relieved by arch-like openings, each 2 feet 2 inches span by 8-inch rise with 12-inch bearing between.

When the concrete floor system is completely set and dry its surface is coated with an asphaltic paint binder applied with broom to give a thin, uniform, black, glossy film, hardening in two hours. On this film, as soon as hardened, an asphaltic wearing surface is laid which averages 1½ inches thick after compression. This wearing surface is made of 7½ to 10 per cent. bitumen, 8 to 17 per cent. stone dust and the remainder broken stone or gravel and sand held by a 200-mesh sieve and passing a No. 2 sieve, in specified proportions of various sizes.

The grade of the trestle is level from end to end. The extra 2-inch depth of the caps of the pile bents at the center of the roadway is all thrown into the top, so that there is almost a 2-inch crown to the roadway in its 21 feet of width, enough to drain the roadway, the water running out thru the openings in the wheel guard or curb above described.

REVISION OF WATER RATES IN BLOOMINGTON, ILL.

The income of the water works of Bloomington, Ill., in 1913, was $50,316.03, and the operating expense of the water and light department (street lighting only) was about $26,000.

The city has 5,000 water meters in use.

The State Utilities Commission has ordered every city having municipally owned water and light departments to place these plants on strict business basis, collecting from water rents, revenue sufficient to meet operating and maintenance costs and in addition balance that will pay interest on the money invested and create a sinking fund for the ultimate rehabilitation of the plant.

The City Council is considering the revision of water rates in accordance with these instructions and Superintendent Noble reports in regard thereto as follows:

"I know of but few things that would give me more pleasure than to comply with the text of this resolution, but in order to do so it will require the expenditure of $6,000 on the part of the Council to equip the water and light department with the proper meters and instruments for ascertaining these costs. Instruments needed are: A 20-inch water meter, cost $1,000; four recording watt meters, cost $400; two recording steam flow meters, cost $500; one hot water meter, $700; one track scale for weighing coal, $1,500; expense of installation, $1,000; expense of bookkeeper and accountant, $900."

Mr. Noble recommended that this expense be undertaken if possible.

RATE MAKING FOR PUBLIC UTILITIES

By Prof. W. G. Raymond, University of Iowa, Iowa City, Iowa.

At a municipal conference held at the University of Iowa, Professor Raymond, who is in charge of the Department of Civil Engineering, presented the following clear discussion of the principles underlying the process of establishing rates for service rendered by public utility plants under both private and municipal ownership.

I PROPOSE to discuss this subject with you rather than to undertake to tell you just how rates should be fixed. I am not sure that I know how they should be fixed. I am sure that I am not an expert accountant and hence my methods of dealing with the subject may not pass the accountant's tests. I shall try to present what seem to me to be certain fundamental principles that should guide in rate making and shall ask you to criticize and make countersuggestions as they may occur to you.

In the time at hand it will be impossible to go into detailed argument concerning certain methods of computing depreciation, handling appreciation, etc., but I hope that the general principles enunciated will serve as a basis for your further consideration of details after you have gone to your homes. If then you should have questions to ask, I shall be glad to have you ask them by correspondence and I shall be only too glad to give you such knowledge as I have and refer you to others who have more than I have when I can not answer the questions you ask.

We shall begin by considering a municipally owned plant and shall try to discover what the rates should cover. Let us suppose that the plant cost $100,000, is new, and will last 20 years before it must be renewed. This last consideration is not so simple as it sounds. Parts of the plant will be worn out and renewed in a year, parts will last 5 years, while other parts may last 30 years or even 100 years; the plant must be kept up in working condition all the time, and must be extended with the growth of the community or its business; and all these things are included in the simple statement that the life of the plant is to be 20 years.

The cost of the plant will be raised by borrowing money obtained by the sale of bonds, we will say at par, drawing 5 per cent. interest. The rate may be high, but it is not material to the present discussion.

Now what must the plant earn? Certainly it must earn the 5 per cent. interest on the bonds. Certainly it must earn its proper operating cost, labor, supplies, and all repairs that are not renewals, and including everything in the way of supervision, corporation counsel's time, treasurer's time, and all general items of this sort which are not usually considered, but should be. Concerning these two items of interest and operating expense, there will be little dispute except possibly as to what is to be included in the second.

Now the plant begins to operate, some rates have been fixed, and let us suppose they are meter rates—not automatic meter rates collected in advance, but meter rates that are collected after the water or gas or electric power has been used. Immediately expenses will begin before rates are collected and it is found that working capital is necessary. We may get this by drawing on the treasurer if there is any fund available, or we may

borrow it. No matter how we get it, we shall have to pay interest on it, directly or indirectly. Therefore, I think we should include interest on a sum that we will call working capital. This amount we will not now discuss.

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¶ THE INVESTMENT *must receive its compensation and must be repaid by the time the plant has worn out.*

The plant must be made good when it is worn out, and, if we say its average life is 20 years, we should lay aside each year at least such a sum as that which, placed at compound interest, will aggregate $100,000 at the end of 20 years. This we may call a sinking fund, or depreciation fund, or what not. Its purpose is to renew the plant at the end of its life. We don't always think of it in just this way. We think of it as a sinking fund for the retirement of the bonds. But if we retire the bonds in 20 years and the plant is then worn out we must borrow another $100,000 to build a new plant. Such a thing cannot occur. We must renew parts of the plant from time to time, so that at the end of the 20 years we shall have a plant as good as new. The $100,000 should never be paid. That is invested capital. Future generations should expect to pay interest on the same capital, provided that the plant it represents is kept up to 100 per cent. and serves them as it serves us. It may be necessary to put in extensions to the plant, and, if so, the necessary money may be taken from the sinking fund, which will necessitate borrowing later for replacements, or it may be borrowed as needed. If borrowed, it will be additional capital invested in the plant and capital interest must be paid on it. If sinking fund money on hand and not needed for renewals at a given time is put into extensions, it should be considered not to be new capital invested in the plant, but should be considered as keeping the original capital intact. An equivalent amount will eventually become new capital when it is borrowed to replace part of the original plant.

¶ THE ITEMS *which must be covered by the rates for service are recognized and set forth.*

For the present let it suffice to say that the public must expect to pay in rates:

1. Interest on capital, invested and working.
2. Cost of operation, including repairs.
3. Some sort of renewal fund.

Interest on a given capital can be computed with accuracy. Cost of operation, if carefully kept, with repairs properly separated from renewals, may be accurately known, but the actual depreciation at any time and the theoretically correct renewal fund may not be determined with accuracy. Certain assumptions and theories must be developed to determine what these are as near as may be.

Generally speaking, the laws of Iowa do not require the maintenance of a sinking fund for the retirement of bonds. The laws prescribe the term of the bonds, but they may be paid by refunding so long as the legal debt limit is not exceeded. I am disposed to suggest that this debt limit should be quite large if it is to include money borrowed for publict utilities that yield a direct return, such as water works, gas plants, electric light and power plants, street railroads, etc.

Many smaller communities are building new works and must fix rates in the beginning without knowing how many customers are to be served or what the expense of operation is to be. An estimate must be made, and rates fixed subject to adjustment after a little experience has shown what the expenses are to be and what sale there is to be for the output of the plant.

Any public service plant owned by a municipality except, possibly, street railway plants, rarely so owned in this country, gives a service to the public for which the whole taxable public should pay. A lighting plant lights the streets and a water works system furnishes water for fires, for street cleaning, sewer flushing and other public uses. It seems to be proper that all property served or to be served by water mains or gas mains which have been laid, or electric light wires which have been strung and street

lights operated, should pay a portion of the return that must be collected to cover the three items of interest, cost of operation and depreciation. The part that such properties should pay should be levied as a separate item in the tax, collected by the tax collector or treasurer and placed to the credit of the public service plant for which the tax is levied. Again all citizens who make use of the streets and the government and are subject to taxation should pay a part of the rates, in addition to that paid by the property actually or potentially served by the utilities lines. Thus there are three parts into which the income should be divided for collection.

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¶ THE SOURCES *of income of a municipal plant are insisted upon, as many municipally operated plants do not avail themselves of all these sources.*

1. A portion levied on every taxpayer for the general service to all citizens.

2. A second portion levied on all property enjoying potential or actual service because of the existence of the service lines in its vicinity.

3. A third portion paid by the users for the actual service rendered to them exclusively.

A municipally owned plant should pay the three items of interest, operating expenses and depreciation from the start, and since the number of customers and the quantity of output sold in the earlier years of the plant will be relatively small, it is suggested that in the beginning a relatively larger portion must be borne by the community as a whole for actual public use and potential private service than will be proper in later years, when a much larger output may be sold to individuals and the common tax reduced.

The following is suggested as one way to apportion the amounts to be paid by the public at large and the individual users: Measure the output at the plant, meter all individual connections, including public buildings, and estimate the quantity used for public purposes on streets and at fires. The difference between the total output and the measured and estimated use is the loss or leakage. This may be divided between the users as a whole and the community as a whole in proportion to the measured and estimated quantities used. Augment the total private use and the total public use by the portions of the leakage or loss thus assigned to each and divide the sum of the three items, interest, cost of operation and depreciation, between the two augmented totals as indicated in what follows.

The sum of the three items, interest, cost of operation and depreciation, divided by the entire output, will give the average cost per unit of output.

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¶ THE SHARES *to be paid by the public at large, by property benefited, and by consumers, are not always as equitably divided as is here proposed.*

A more or less arbitrary portion of the whole expense may be levied against real property served or to be served by the plant. What remains should be divided between the public at large and individual consumers in proportion to the total quantity of output used. So much as is to be paid by consumers for use should be arranged with a sliding scale, to be determined for different utilities in different ways, so that the larger users shall pay the lower rate, since the cost of service to a single user is not in proportion to quantity of output used, but is less per unit as the number of units is greater.

In the case of water works plants in small or moderately large cities the portion to be paid by the general public for fire protection is larger than would be obtained by considering only the amount of water used. Water mains must be much larger than would be required for ordinary business and domestic consumption in order to furnish large quantities of water in short periods for fires. Moreover, for the same reason, when the water is supplied by pumps the pumps must be of greater capacity than necessary to furnish the domestic and business supply. These differences may well be estimated and the interest and depreciation of the portion that may be necessary for fire

protection only should be included in the general levy on all taxable property, only the balance of these items being used in the sum to be divided as before described. This concludes the statement of general principles underlying proper rate making for publicly owned utilities.

Now, let us suppose that the municipality prefers not to engage in the business itself, but wishes to hire some person or corporation to do its business for it. Should there be any difference in the allowed rates? I think there should to this extent: That the individual or corporation must be paid a wage for doing the business. This wage may, and ordinarily will, take the form of a larger return on the capital invested than mere savings bank interest and should be such as to be fairly called interest and profit on the invested capital.

It would be well to make the articles of employment, called the franchise, such as to reduce the risk to the individual or corporation to a minimum, and it might even be agreed that in return for good service with a plant reasonably well designed, constructed, and operated, to the satisfaction of the municipality's engineering officer, the company should be guaranteed against loss from the start by rates leved much the same as for a municipally owned plant. Such a guarantee would lessen the risk and reduce the interest rate on the companys' securities, and, hence, the total rate that the public should pay. And it might be further agreed that when the company should be on a paying basis, it should receive a higher wage in proportion as it increases efficiency and reduces the cost of service.

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¶ IF THE CITY CONTRACTS *with a private company for the desired service, the rates must allow for the payment for the business ability and time required to carry on the business.*

And this indicates the theory I hold in common with some others, namely, that a public service corporation is a public agent, supplying money, constructing works and operating them for hire; that it should be paid for the use of its money at a reasonable interest rate; that it should be paid its operating expense; that it should be repaid the sum that may be reasonably invested in its plant by the time the plant is worn out or obsolete, and must be replaced, or what is the same thing in effect, but not necessarily in amount, the cost over repairs of keeping the plant at 100 per cent. value, and it should be paid a wage or profit for the service rendered.

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¶ THE ALLOWANCE FOR DEPRECIATION *is the bugbear, estimates only being possible, with insufficient data upon which to base them.*

The only item in all this that is really difficult to determine is the item of replacement, or, as it is generally called, depreciation. There are many ideas as to how this item should be treated. It has been suggested in an earlier part of this paper that the sum to be laid aside annually for depreciation or renewals is that sum which, placed at compound interest, would produce the cost of the plant at the end of its life, but this may be questioned even in the case of a municipally owned plant, and is certainly not the proper sum in the case of a privately owned plant. Because renewals of parts of the plant will be required in a few years and will continue at intervals during the entire life of the plant, some items being renewed several times during the lives of other items, it is not feasible to place the depreciation allowance at interest, unless, possibly, the lives of each class of items, short lived and long lived items, have been considered separately and depreciation allowances fixed accordingly. In the case of a privately owned company it is not proper to require the company to place the depreciation allowances at interest in order to realize the full investment by the time the plant has been entirely replaced. Rather should the whole sum be returned to the investor by that time. We should then regard the depreciation allowance in the rates as a return of capital and should so arrange it that it will be less at first and more at the last, since the renewals are likely to be greater as the plant

grows older. But it is also desirable for rate making that the total allowance for interest and renewals shall be practically uniform from year to year. The committee appointed by the American Society of Civil Engineers to report on methods and principles to be used in the valuation of public utilities has devised a way of meeting these requirements, which is as follows:

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¶ PRACTICALLY *depreciation is not equivalent to sinking fund in amount or method of estimating or computing interest, tho the final result should be the same.*

The different classes of items are considered separately and for each class that sum is found which, placed at compound interest, will produce the cost of the items at the ends of their lives. Summed for the several classes, this is the first year's depreciation allowance. To this is added interest on the whole investment for the total allowance on account of interest and depreciation. The depreciation allowance being considered as a return of capital, it is subtracted from the total investment, the plant representing which is presumably worth that much less because of the assumed depreciation. Interest is computed on the first depreciation allowance and added to that allowance for the second year's depreciation allowance, and interest is computed on the original investment depreciated by the first year's depreciation allowance for the second year's interest allowance. The sum of these two items is then the whole payment in rates for interest and depreciation for the second year. The method is continued from year to year.

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¶ REPLACING *worn-out parts from the depreciation fund should keep the plant always up to* 100 *per cent. efficiency, thus preserving the original investment exactly as it was when built new, whether as a whole or in parts.*

The total depreciation payments made during the life of the plant will equal the whole original investment, and the subtractions from capital will reduce the original capital to nothing at the end of the life of the property. If the plant has been maintained at 100 per cent. efficiency or value, it now represents just the capital originally put into it, and the payments from the public should go on as before. If it were possible to conceive of such a thing as the gradual and finally complete destruction of the plant by reason of its use and the failure of the company to reinvest in it the sums allowed for depreciation, and this result should obtain at the estimated end of the life of the property, there would be no further service, and no further payments due. The company would have received interest on all the capital actually invested in the plant at all times up to the end of its life, cost of operation and profit or wage for its service; and would have received back also the capital it had originally invested. It would thus stand even, having received interest on its capital while in use and pay for the service given. Of course, no such thing could happen because if the plant were allowed to run down the service could not be maintained and would cease to be efficient long before the end of the life of the plant. The property must be considered to be a permanently continuing enterprise.

If the same rate of interest is used for capital and depreciation the annual payments will be equal.

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¶ THE OPERATOR *of the public service industry, if under private ownership, is entitled to ample payment for his services, and, as in all other business enterprises, he is entitled to a reasonable profit. He is not permitted to take advantage of the monopoly granted him to charge excessive rates for the service, and his profit must therefore be limited.*

If the interest allowed on capital differs from that allowed in computing depreciation the payments will not be quite uniform and if the interest on capital is the greater, the totals will be somewhat greater at the first than at the last. This is undesirable, but can not be avoided under the plan which allows profit in the shape of large interest on invested

capital. I suggest that interest be the same on capital and depreciation allowances and that profit or wage be computed on cost of operation.

The business man in any private commercial enterprise expects to earn interest on his invested capital, wages for his time and energy in directing the business, and a profit as well. It may be said that he should expect to earn only interest and wage and this may be true, but scarcely anyone will deny that the wage should be commensurate with the risk and magnitude of the enterprise. No one would expect a Marshall Field managing a business of millions of dollars yearly to be satisfied with the same wage that would satisfy John Smith, who conducts a suburban corner grocery doing an annual business running not far into the thousands of dollars. And no man or group of men can be expected to undertake public business, unless a wage is permitted that is commensurate with the risk and the magnitude of the undertaking. Of course, the capital invested will largely measure the magnitude of the undertaking, and yet this is not always so. A bank with a comparatively small capital may do a very large business and consequently earn a very large dividend on its capital, tho not earning an exorbitant percentage of profit on the business done. Just so, by fortunate location and wise planning, one public enterprise may do a large business on a relatively small capital when compared with another less favorably located or less wisely constructed. Hence it seems to me that if possible the profit or wage allowed the corporation should be allowed as a percentage of the cost of operation, it being understood that there will be supervision to the extent of preventing undue padding of this cost, and an agreement whereby the profit or wage may be larger as the cost per unit is smaller.

METERS AND RATES IN THE LOUISVILLE WATER WORKS

The Louisville Water Works management has a way of lowering water rates by increasing the discount for prompt payment, which now makes the difference so great that prompt payment is almost a universal rule. In 1912 the discount was 25 per cent, but in 1913 it was increased to 33 1-3 per cent.

The gross amount of bills shows the increase in business of the water works, being 8.2 per cent in 1913 over 1912, but the increase in discount reduced the actual receipts for water by $24,711.21, or 3.7 per cent.

The total number of services in active use in the city was 35,610, of which 4,312 are metered. These are all of the larger consumers, meters being applied under present rules when the bills paid amount to $36.50 a year or more. More than one-fourth the metered consumption runs thru 35 6-inch meters, and nearly two-thirds of it is thru 539 meters of 2 to 6-inch size; so that the average consumer does not have a metered supply. At present 42.2 per cent. of the supply is metered and pays 46.7 per cent. of the revenue, while 57.8 per cent. is not metered and pays 53.3 per cent of the revenue. The latest report of Chief Engineer Theodore A. Leisen recommends the lowering of the minimum bill for which meters would be installed to $29.20 a year and a daily allowance for that rate of 533 gallons. This would largely increase the number of consumers who would pay only for the water they used. Under present rules, the ⅝-inch meters, smallest size in use, which were in use thruout the year, averaged 632 gallons a day.

CHICAGO BUILDS MOTOR CARS

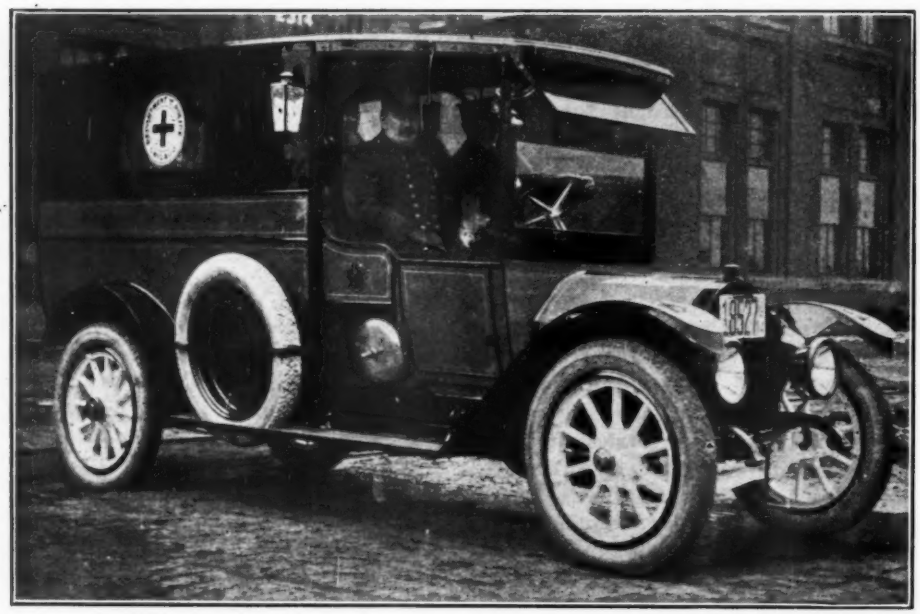
By Warfield Webb, Chicago, Ill.

This is a report of an experiment which the City of Chicago is making in assembling motor cars in its own shop and it has the enthusiasm of novelty. A couple of years' experience will demonstrate its advisability and show whether the first estimates of saving in cost of machines have been overdrawn.

A NOVELTY is the building of some newer types of automobiles for the police department of Chicago in the city's own plant. The first of these is one of a number of police ambulances, embodying a number of pleasing features, that was constructed at the city's shops, under the direction of C. J. Brethauer, in charge of this department. Before the end of the present year there will be nine of these cars built at this shop, and there will be at least a saving of one-half to the city. This is the first instance where a city has manufactured its automobile ambulances in its own plant and by city-paid men.

The new cars are known as the light-weight type, and are capable of attaining a speed of from fifty to sixty miles per hour. The cars are fitted with 60-horse-power, 4-cylinder engines, and each car weighs about 3,300 pounds. The bodies are of deep blue, with white wheels and 5-inch pneumatic tires. They are extra long and carry a complete ambulance outfit. The inside of the cars is white enamel, and embodies the very latest ideas in this character of municipal adjunct.

All the parts of the car are standardized and interchangeable, and in the event that a car should meet with an accident, the damaged parts can be duplicated at a very small cost. The construction of the cars is under the juris-

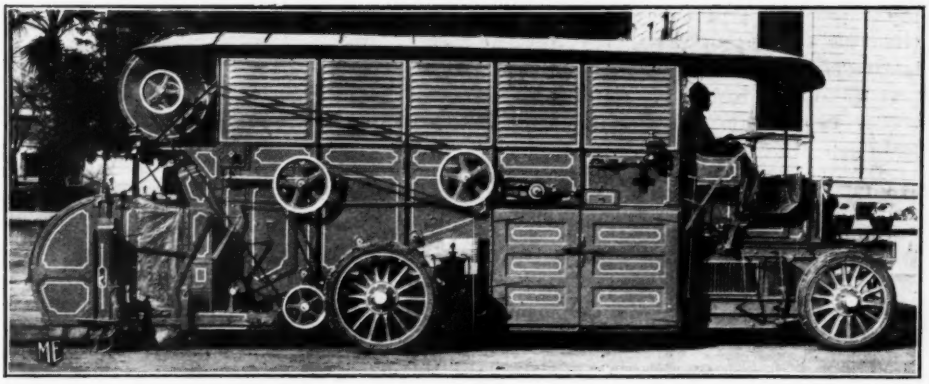


diction of the Second Deputy Superintendent of Police.

In addition to the motor ambulances there have also been added to the police department, and portions of these have been assembled at the above plant, clever motorcycles, equipped with pulmotors, and able to carry a physician in a contrivance that is a part of the cycle, where a hurry-up call for the above device is demanded. In cases of asphyxiation or drowning only a minimum amount of time will be consumed in reaching the sufferer. There are eleven of these attached to police stations that have been fitted up as emergency hospitals. The speed of these cycles can be as high as sixty miles an hour.

Automobile dog catching wagons are likewise manufactured here, and these have proven to be effective methods of ridding the city of rabid dogs and others that are found without license. These are only a few of the several styles of motor cars and other vehicles that are turned out in this department. The saving in cost in all cases is large enough to make possible a material saving in operating costs, and also permits a larger number of cars to be placed in commission.

MOTOR DRIVEN STREET SWEEPER IN OAKLAND, CAL.



GERMAN MOTOR TRUCKS AND TRAILERS

The train of wagons hauled by a motor truck has been an impossibility except on the hardest and most nearly level roads, because the tractive force available thru the friction of the motor wheels on the road surface has not been sufficient to handle more than one, or perhaps two, trailers. This German solution of the problem utilizes electricity generated on the motor truck and transmitted to motors on each trailer. truck, thus making each nearly independent as to motive power, tho controlled as to speed and direction by the driver of the motor truck.

THE accompanying photograph and drawing show one of the modern automobile road trains developed at Berlin-Steglitz as designed and constructed by the W. A. Th. Mueller Strassenzug-Gesellschaft.

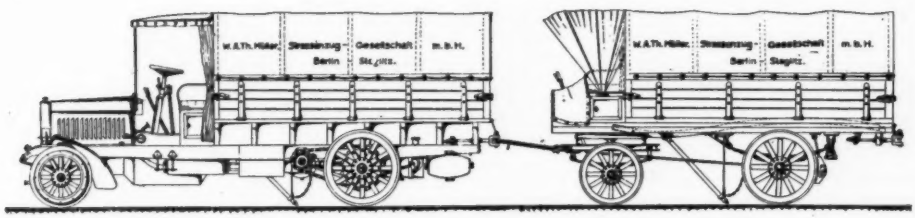
The service by automobile road trains may be compared with that of small or electric railroads, with the advantage of not being limited to one road, so that a service of automobile trains can be made profitable even in districts with very small traffic; so much the more, as the number of cars in a train can be adapted to the requirements down to a single engine-truck with one trail car.

In Germany the automobile road trains thus afford a means of conveyance which forms the missing link between the large service of railways and the individual service by wagon and automobile. Wherever there exists today the desire for an electric or small railroad line, and where the construction of the same is impossible on account of insufficient returns, automobile road trains will fill the gap.

It was hoped to be able to haul loaded trailer cars in the same manner as on railroads and thus convey large loads. Soon, however, it was found that this was only possible up to a certain extent and on level, well-constructed roads. Even the traction engines with four driving wheels were not able to produce the necessary tractive force with absolute certainty if they were not very heavy machines.

These attempts, however, were not without certain results. They have shown that the traction principle can be employed when the tractor itself carries as large a load as possible and the number of trail cars is reduced down to one. On this principle the German engineers constructed their automobile road trains for small loads. The tractor carries, as a rule, a load of from 4,000 to 5,000 kg. (8,800 to 11,000 pounds), and the trail car a load of 2,000 to 5,000 kg. (4,400 to 11,000 pounds). Notwithstanding, the load on the driving axle of the tractor does not exceed the maximum weight of 6,000 kg. (13,200 pounds). In special cases, where roads and bridges allow of greater loads, the capacity of the vehicles is raised to 6,000 kg. (13,200 pounds) each, so that a total of 12,000 kg. (26,400 pounds) can be conveyed. The design of these road trains embodies all the latest improvements in automobile engineering. A new type of trains has been developed at Steglitz for loads up to 50,000 kg. (110,000 pounds).

After the failure of the traction engine principle the automobile road train for greater loads remained for a long time an unsolved problem. The elementary reasons for the failure were found by a comparison of the iron rail with the surface of a highway. The resistance of vehicles against propulsion on a road is from three to ten times as great as on rails and the friction of the driving wheels at the point of contact with the road for de-



Benzole engine: 31/50 h. p. (also for heavy benzene) *Working load hauled: 13000—20000 lbs (6000—10000 kg)* *Maximum load on axles: 13000 lbs (6000 kg)* *Speed: 10 miles p. h. (daily capacity in 10 hrs. abt. 80 miles)*

GERMAN AUTOMOBILE *road train for small loads. Gasoline motor car and single trailer without motor, carrying together* 13,000 *to* 20,000 *pounds of load.*

veloping their tractive force, particularly on hard pavements and in wet weather, may be smaller. The consequence is that only by positively driving several wheels can success be attained, i. e., it is necessary to apply a driving power not only to the wheels of the tractor but also to those of the trail cars.

The difficulties became apparent by tests and trial runs which had been continuously made for several years. In these experiments it was attempted to obtain the direct drive of the trail cars by a jointed driving shaft running thru the entire train. This developed in the coupled wheels forces quite uncontrollable. The wheels of the trail cars coupled to the driving mechanism developed propelling forces and no braking effects, whereas a perfect control and regulation of the propelling forces of all the wheels from the driver's cab and an absolutely reliable working of the whole mechanism is essential. The propelling forces of the wheels must not have any detrimental influence on the steering gear of the train. In order to reduce the wear on the roads to a minimum the single vehicles of the road train must not exceed a given weight and the load must therefore be distributed upon a large number of cars. A train of great capacity must consist of many vehicles, and these must be steered in such a manner that one positively follows the other, however long the train may be. As each single vehicle successively advances automatically into the position of the preceding car, the driver can avoid obstructions and prevent collisions with other vehicles, regardless of the length of the train. It is claimed that all these problems have been solved in a scientifically correct and at the same time technically reliable and practical manner by the German automobile road trains for heavy loads illustrated. Such a train has six motor trail cars, each of 5,000 kg. (11,000 lb.) capacity. The engine power suffices to haul ten such motor trail cars, making a total load of 50,000 kg. (110,000 lbs.).

The only solution for this problem thus far developed is the electric transmission of power between the engine and the driving wheels. The energy developed by the engine is, therefore, transformed into electric energy and supplied in this form to electric motors.

As a source of power, combustion engines with gasoline or oil fuel are employed, as these motors combine great power with small weight and allow of carrying a sufficient quantity of fuel to last for a whole day's run of 60 to 90 miles. In special cases, where these points are of less importance, steam engines for oil, wood or coke are employed.

In the Mueller automobile road train the first vehicle, noticeable by its peculiar shape, is the one which contains the necessary engines for supplying the power. It is, therefore, aptly termed the "engine-car," or "tractor." At each end a combustion motor is arranged with the necessary cooling arrangements and all other accessories and between these two engines stands the driver's cab, in which

all levers for operating and steering the whole train are placed.

Each of the combustion engines is directly coupled with a dynamo, so that there are thus two separate independent generating aggregates, which may be employed together or separately, according to the amount of power required, the length of the train and the condition of the roads. The regulating devices for the dynamos allow of varying their working pressure from nil to the maximum in a very gradual manner. The current thus generated is supplied by means of a cable, which can, of course, be disconnected between two vehicles, along the whole length of the train to the electric motors at the driving wheels.

The engine-car and the motor trail cars are constructed in such manner that they can be run in either direction. For reversing the direction of travel they therefore do not require to be turned around. For this reason the driver's cab on the tractor is double-sided, and there are two independent steering gears, one for each axle. The driver is, therefore, in a position to steer either the front axle only, according to the direction of travel, or both axles. Between the several vehicles there are provided the cable junction and mechanical coupling contrivances for holding the train together. These must serve at the same time for operating the positive steering of the motor trail cars in the direction determined by the driver for the travel of the engine-car.

These couplings have been designed in a very ingenious manner for the necessary steering effect, and also to allow the whole train to travel backwards, by simply detaching, reversing and rehanging the chains. The engine-car may be arranged at any part of the train, in front, at the rear or in the middle, so that the shifting of the train can be carried out as on railroads.

It should be mentioned that the entire steering of the whole train is carried out by the driver on the engine-car and no further help is, therefore, required on the train. For starting the train the driver need only start one of the engine aggregates. The second aggregate can be started or cranked up at any time during the travel with the aid of the first aggregate. A main switch serves for setting the electric connections to "forward," "stop," "brake" and "backward." This switch can, however, only be operated when the dynamos are free of tension, and the switching is thus carried out only when the wires and cables carry no current, so that the contact surfaces cannot be burned.

The starting and the varying of the speed is obtained solely by exciting the dynamos, i. e., by operating the shunt regulator of the dynamo, in which there are currents of comparatively low tension only, thereby obtaining unsurpassable

MOTOR TRUCK *in front, with two gasoline engines generating electricity. Trailer chassis behind, each with an electric motor supplied from generators on the truck and steered by the operator of the truck.*

reality and safety of regulation. The starting is thereby effected as quietly and steadily as when the steam valve is gradually opened on a locomotive. In a similar manner the electric brakes of the train are put into operation, and act under perfect control of the driver uniformly on all wheels.

In addition to the electric brake each vehicle is provided with a hand brake, which acts on all four wheels. Trains intended for use in mountainous districts are furthermore fitted with a second continuous brake, which may be operated either electrically or pneumatically. A complete train includes amongst the other contrivances a flexible conducting cable for facilitating the shifting of single vehicles. By means of this "shifting cable" the motor trail cars can be supplied with current and be brought from distances up to 3,000 m. (10,000 feet), or be sent that distance, respectively, without the engine car having to be moved from the spot.

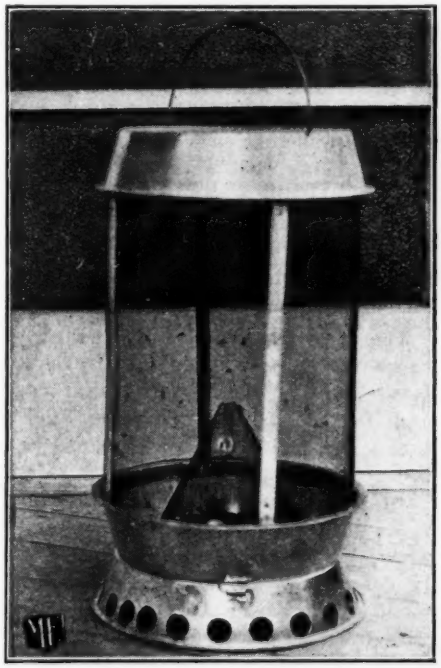
Not in all cases do the trains require all wheels to be driven, as some cars can be included in the train which contain no electric motors and driving gears. It is advisable to make up a train in such manner that more than half the number of axles are driven, as on the number of driven axles depends the reliability of the operation of the train.

Experiments have shown that field roads can be traversed without difficulty, the speed alone being slower. The train can also travel on sandy soil, meadows and prairies. Even if one or another of the wheels should furrow and sink into the soil, the train will not be stopped, as the other axles continue their propelling effect and will draw these wheels out onto solid soil. As long as the soil is capable of bearing the load, the applicability of the road trains is practically unlimited. The wheels have broad steel tires without any projections which might damage the road, and even have a smooth, leveling effect. Therefore the road cannot be destroyed.

MUNICIPAL FLY CATCHER

The City of Redlands employs a man whose sole duty it is to look after our municipal fly traps which are placed on the sidewalks in the down-town section by our merchants. This man baits and empties the traps daily.

These traps are made on the multiple cone plan and in different sizes, although the character of the type is uniform. From September 1st to September 24th, or the first three weeks after these were all in place, this official, A. E. Chapman, caught fifty gallons of flies in the traps, which he estimates to be equal to 3,750,000 flies. The local papers state that these traps have kept the business houses almost entirely free from flies. Each day the traps on the streets are baited with material which will attract the flies, first being emptied of those which had been collected during the previous day. The flies thus collected are burned.



Control of Check Valves

ON EMERGENCY FIRE SYSTEMS CONNECTED WITH REGULAR WATER SUPPLY PIPES

By J. Walter Ackerman, Superintendent of Water Works, Auburn, N. Y.

Some years ago the city of Auburn had a serious epidemic, the source of which was traced to polluted water used in the special fire-protection systems of certain factories, which were connected with the regular water supply pipes. The check valves on these lines leaked and the polluted water got into the city water supply, causing the epidemic. This paper before the American Water Works Association describes the methods of testing the tightness of these check valves which are now in use.

IN the year 1908 the Water Department of the City of Auburn, N. Y., caused an examination to be made of the check valves of the mill and factory connections in the City of Auburn. And, as these check valves were of the type that are bought on a competitive basis, and simply represented a design made looking towards an economy of material and labor, the results of this examination can be easily imagined.

It was found in many cases that even the locations of the valves were unknown to the factory, and some had been buried in the ground for a period of twenty years, without ever having been examined. The final result of this inspection was that each and every mill or factory using city water for fire protection, and having a polluted auxiliary supply, was required to install double check valves of a special design, and to be placed in a brick or concrete vault, accessible at all times to inspection and test.

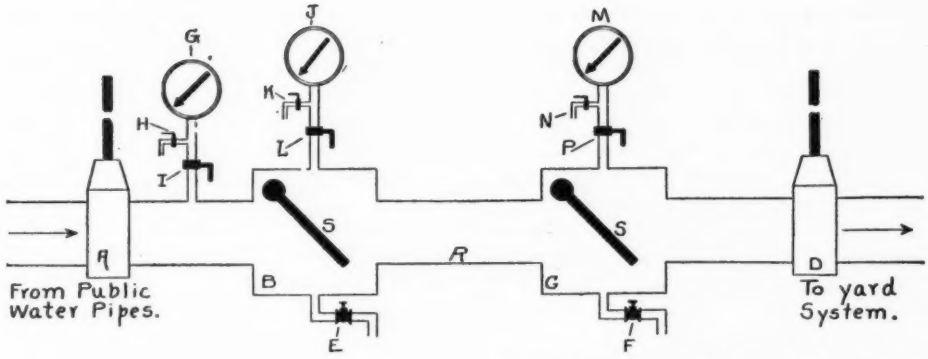
The specifications under which the check valves were made require that the seat ring, disc holding ring and screws, and, in fact, all moving parts, and the hinge pin and bushings of same be of bronze, the disc to be faced with medium hard rubber and liberal clearance to be made all around the clapper, the pin, the arm, etc. These specifications were largely determined by the inspection department of the Associated Factory Mutual Fire Insurance Companies of Boston, and they also had to meet with the approval of the Water Department of the City of Auburn.

The regulations are that they shall be tested once every six months by the Water Department, and taken apart once each year and examined for defects or obstructions, and during this latter inspection a representative from the Associated Factory Mutual Fire Insurance Company is present to observe the condition of the valve and assist at the test.

It is specified by the Water Department that the inspection and test shall be at the expense of the factory or mill where the tests are made.

Figure 1 shows a diagrammatic representation of an installation made in the City of Auburn. The stop gate valves *A* and *D* are so placed in line as to absolutely shut off the water from the check valves. On the entering side, between the first valve *A* and the check valve, is a tap with cock and air vent, on which is placed the pressure gage *G*. Likewise, two other taps on the two check valves are made with the same type of connection. Tapped into the bottom of each of the check valves is a ¾-inch connection, controlled by cocks *E* and *F*.

The actual test is made as follows: Closing gate *A*, either the cock *E* or the air cock *H* is opened. The pressure at *G* only should fall if the check valve *B* is tight and the gate *A* is tight. It sometimes happens that the opening of the air



TYPICAL ARRANGEMENT *of check valves to prevent water from factory fire system leaking into the city water supply system with which it is connected.*

cock *H* releases the pressure so slowly that the back pressure on check valve *B* will not seat the clapper *S* in valve *B*, and the gages both *G* and *J* will fall; while if the ¾-inch cock *E* is opened the valve *B* will close tight. This simply gives the degree of sensitiveness of the check valve, and indicates its condition; for if the air cock does not show it absolutely tight, the drip *E* may. This generally shows that the rubber facing on the clapper is either coated with slime or, some small indentions occurring, allows the water to pass thru this valve. The conditions of tests are slightly different, depending upon whether a mill has one connection or two. If it has two connections there is always present the city pressure from the other connection coming back to the two valves; whereas, if there is only one connection, there is only the static head, or else the fire pumps in the mill are started, and pressure is created in that way. If the flow from *E* or *H* is continuous, it is an indication that there is a leak either thru both check valves or thru the stop gate *A*. If the pressure with *E* and *H* open drops on *G* only, and not on *J* and *M*, it is the gate *A* leaking; but, to make absolutely sure, allow all the gages to assume the normal pressure, and then suddenly release *F*. If gages *J* and *G* drop, and M does not, and flow continues, then it is an indication that the leak is thru *A*, and not thru *B* and *G*.

After the condition of gate *A* and check valve *B* have been thoroly determined by the above method, then the opening of air cock *K* or drip *F* will disclose whether there is a leak on check valve *G*. And, as before noted, if it shows a leak with *K* open, and tight with *F* open, it simply does not seat properly under a low differential pressure. And this is important, because the valve is called upon to act when the fire pump raises the pressure above that of the water in the city mains. And there always will be a time when the pressure on each side is just equalized, and then the pressure on the mill side will begin to build up above that of the city side. And while the test may show from both the drips a tight condition, it will not show a tight condition when only the air cocks are used slowly, allowing the difference in pressure to be gradual.

In order that a number of trials may be made on check valve *B*, pressure should be taken from some source and introduced between the two valves. It is preferable in this case to take the pressure from the main on the mill side between check valve and the mill or factory and allow it to come in thru either the drip pipe *F* or some other place, in order to balance the pressure on each side of check valve *G*. Then this by-pass connection would furnish water for unlimited trials on check valve *B*, independent of check valve *G*, for any water which leaks thru *B* would be replaced by the by-pass connection, which, if it was not there, would soon be exhausted if check valve *G* was tight.

The actual value of the test is obtained after it is completed and the examination made of the interior to show actual conditions, such as tuberculations on the iron body, the smoothness of seat ring, the condition of the rubber facing on clapper, and the manner of the closing of the valve. And, while the test is only to show working conditions, the examination shows the way the valves are living up to the requirements imposed upon them.

The rules in our department which control the installation of check valves and kindred appurtenances are as follows:

No water pipes in any building or premises supplied with water by the city shall be allowed to receive a supply of water from any other source except in case of pipes used exclusively for fire protection that conform to the requirements given below.

No connection of the city mains shall be allowed with pipes having another source of water used for miscellaneous purposes except to a tank open to the air, nor shall such pipes have any physical connection with the pipes used for fire protection.

Between the pipes used exclusively for fire protection and the city mains there shall be two check valves placed between two positive valves and located in an accessible brick or concrete pit, with such valves, gages and connections as may be prescribed by the water board for each installation and for the purpose of testing. The check valve shall be of a type approved by the water board. The check valves shall be kept in working order by the consumer and shall be at all times subject to inspection and test by the superintendent of water works, the cost of such test being borne by the consumer. The pure water pipes that have direct connection with the city supply, before the same have passed through the aforesaid double check valves, shall be painted blue; the pipes used exclusively for fire protection shall be painted red, and the pipes carrying the impure water and used for miscellaneous mill purposes, but not for drinking, shall be painted yellow. These different systems of pipes shall not have any physical connection with each other in the mill or factory.

There shall be placed on the discharge main of the fire pump a check valve and positive gate. The latter shall be kept closed and sealed by the superintendent of water works, and opened only in case of fire or for the purpose of occasionally testing the fire system, but notice of such occasional test shall be given to the superintendent of water works, and, during the test, the positive gate between the fire system and the city main shall be kept closed. During the weekly trials of the pump prescribed by the fire underwriters the water shall be discharged either thru the relief valves of the pump or thru hose connections from the pump.

CONCRETE ROADS IN ILLINOIS

The Illinois State Highway Commission completed last fall and now has in service two concrete roads running out of Edwardsville, which are 16 feet wide, the bids being nearly the same as for a 9-foot concrete road with macadam shoulders. The Troy road is 6,300 feet long, 11,200 square yards of concrete, and has expansion joints 40 feet apart, protected with steel plates. During construction the fresh concrete was shaded by an awning about two feet above it and as soon as it had hardened sufficiently earth was thrown on it, and kept wet for several days. The proportions of concrete were 1 Universal portland cement, 2 sand, 3½ crushed limestone.

The Old Fairgrounds road is 3,900 feet long and 18 feet wide, 7,800 square yards of concrete, and has a grade of 8 per cent. in one place. The foundation being of stiff clay, curbs were put along the edges of the brick surface on the hill to prevent washing of the shoulders.

Illinois State Highway Department specifications were used. Dunlap-Dippold Company and Geo. R. Hyten, both of Edwardsville, were the contractors on the respective roads.

WATER WORKS OF BRIDGETON, N. J.

This clear and concise account of the new water supply system of Bridgeton, N. J., is taken from the report of Henry Ryon, designing engineer and superintendent, and will be of interest to many operators of small plants who have similar problems to solve.

THE city of Bridgeton, N. J., began the agitation for water works as early as 1872, when its population was not much more than 5,000, and succeeded in building a plant in 1877 with a supply from East Lake, pump of 1,500,000 gallons capacity, distributing and storage reservoirs. The distributing reservoir was replaced in 1898 by a steel tank in the same location, 100 feet in diameter and 45 feet deep, and this tank was coated inside and out in 1908 with reinforced concrete at a cost of $20,000. It has an available capacity of 2,000,000 gallons and forms a part of the new system which has just been constructed.

East Lake was supplanted as the regular supply in 1887 by a 30 by 30-foot well, and used thereafter as a supplementary supply in dry weather. Galleries supplemented the well, but the supply could not be increased to correspond with the demand and in 1910 Clyde Potts was employed to find a new supply and the new plant was constructed from his designs.

This new supply is taken from the west branch of the Cohansey river, which has a watershed of 46.9 square miles, with four large mill ponds to aid in conserving the supply. Its minimum dry-weather flow is 23,000,000 gallons a day. It has no villages on the area and a small number of farm houses.

The intake, at the upper end of Tumbling Dam pond, is in a neat buff brick house with heavy concrete base, is 6 feet wide by 3 feet high and has three movable screens, one of ½-inch by 2-inch iron bars across the above opening, and behind it a ¾-inch mesh brass screen and a ⅜-inch mesh brass screen, all of which can be raised separately for cleaning. A wooden shut-off gate is provided.

A 30-inch vitrified pipe conduit carries the water under the lake and thru the bank west of the raceway, 14 feet deep in places, some 8,500 feet, to the coagulation basin of the filter plant. It can carry 4,200,000 gallons in 24 hours, with gates wide open, and the difference in level of 4 feet between the two ends. An emergency intake is provided on the raceway below the dam which has also a blow-off gate for draining the pipe.

The accompanying larger drawing shows the lay-out of the pumping station and filter plant and the course of the water thru it can be followed readily. It enters the bottom of an inlet well about 4 feet square at the southwest corner of the basin, rises in this chamber and passes thru a 30-inch balanced float valve into the basin proper. This float valve automatically cuts off the inflow when the water in the basin reaches the level for which the valve is set. An overflow weir in the north side of the inlet chamber at the level of the water at the intake house provides for any surge due to the sudden closing of the valve, and prevents damage being done to the vitrified tile conduit due to water hammer. A 12-inch blow-off gate is provided for drawing off the upper portion of the water in the basin. The lower 4 feet is. however, too low to drain by gravity, and a pipe from the bottom of the basin is connected to the sludge well in the main building, from which the water may be pumped by a 6-inch centrifugal pump operated by a 10-horse-power steam engine.

The soda and alum used in treating the

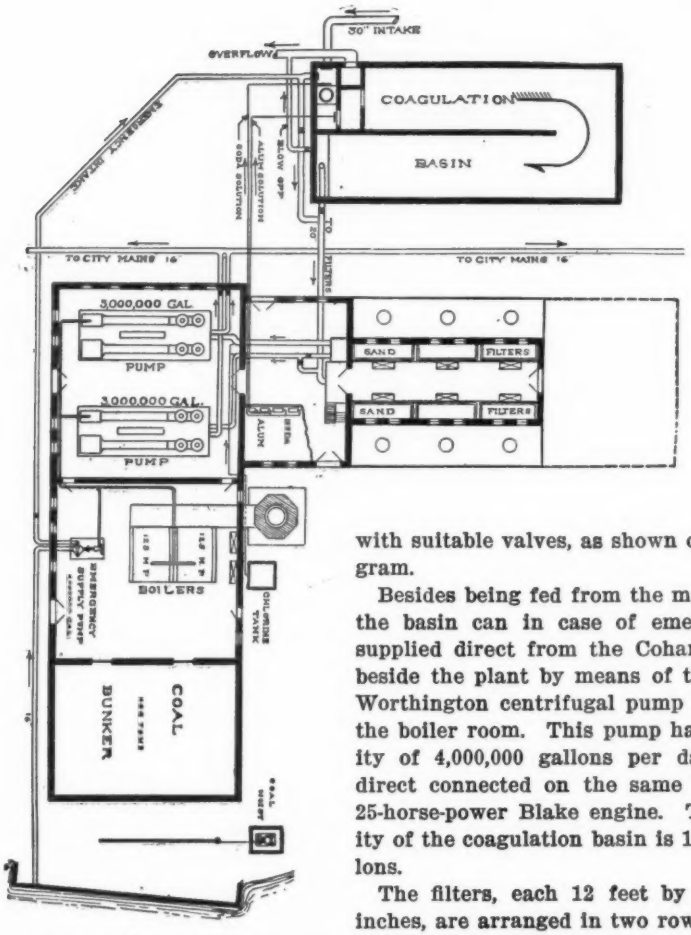


FIGURE 1 *gives the plan of the pumping station, coagulation basin and filters, showing all the connections described in the article and the course of the water thru the plant.*

water are applied in the order named at the entrance of the coagulation basin on opposite sides of the balanced valve. When operating at normal capacity the water requires a little over one hour to pass thru the coagulation basin, moving north on the west side of the middle baffle and south on the east side to the concrete collecting trough, from which a 20-inch pipe carries the water to the sand filters. To provide means of operating the plant while the basin is being cleaned, a by-pass has been built across the end of the basin with suitable valves, as shown on the diagram.

Besides being fed from the main intake the basin can in case of emergency be supplied direct from the Cohansey river beside the plant by means of the 12-inch Worthington centrifugal pump located in the boiler room. This pump has a capacity of 4,000,000 gallons per day and is direct connected on the same base to a 25-horse-power Blake engine. The capacity of the coagulation basin is 150,000 gallons.

The filters, each 12 feet by 14 feet 6 inches, are arranged in two rows of three each on opposite sides of the operating floor and pipe gallery. The 20-inch inlet pipe from the coagulation basin runs the full length of the filter house and is connected to each of the filters by an 8-inch pipe. The water passes thru these pipes into the filters and down thru the 30 inches of sand (effective size 0.4 mm.) and 18 inches of gravel. It is collected at the bottom of each filter by 616 brass strainers, shown in Fig. 2. These strainers are tapped into 2-inch iron pipes, which lead to the manifold in the center of the filter and from which the water passes to a rate-control of the Venturi meter type, and drops into the clear water basin beneath. The rate-controls consist of balanced valves operated by diaphrams moved by the difference in pressure at the throat and full section of the Venturi meter. They prevent the filters from be-

ing operated at a higher rate than that for which they are set.

Mercury column gages are provided on each operating table for showing the head on the filters. When the filters are clean, the loss of head thru them is about 2 feet and the rate-controls automatically close sufficiently to prevent the water from passing thru at too high a rate to give satisfactory results; but as the sediment gradually clogs the surface of the sand, the loss of head increases and the controls open wider, offering less resistance to the flow. After being in operation for from eight to twelve hours, depending on the condition of the raw water, the beds become so clogged as to need cleaning, in order to deliver the required amount of water. This condition is indicated by the mercury gages.

The cleaning is accomplished by means of blowing air and running water thru the beds from the bottom. The wash water is taken from the city mains by a 6-inch pipe which connects to the manifold of each filter, the water entering the sand bed from the brass strainer in the opposite direction from that in which the filtered water leaves. The air is supplied at about 5 pounds pressure by a No. 3 Root blower direct connected to a 25-horse-power Troy engine, and is conducted to the filters thru a 4-inch pipe and distributed over the bottom of the filter by a small perforated brass piping, as shown in Fig. 3.

The air and water break up the crust formed on the filter and the water carries off the dirt from the top of the filters thru a 10-inch waste pipe. When the filters are started after washing, the first filtered water is wasted to the river by opening a valve connected to the same pipe which carries the waste wash water from the top of the filters. The amount of water used for washing is about 1½ per cent. of the total amount filtered.

All valves, except the rewash valve, on pipes connected to the filters are operated hydraulically by turning levers on th operating table. An indicator shows the condition of each valve.

A sampling faucet is also provided on each table for taking samples from the filters separately. The water is drawn to these faucets by a partial vacuum produced by an aspirator. Each filter has a capacity of 500,000 gallons per day.

The clear water basin is of concrete 72

FIGURE 2 *shows the brass strainers on the bottom of the filter, which drain thru two-inch pipes to the manifold running down the center.*

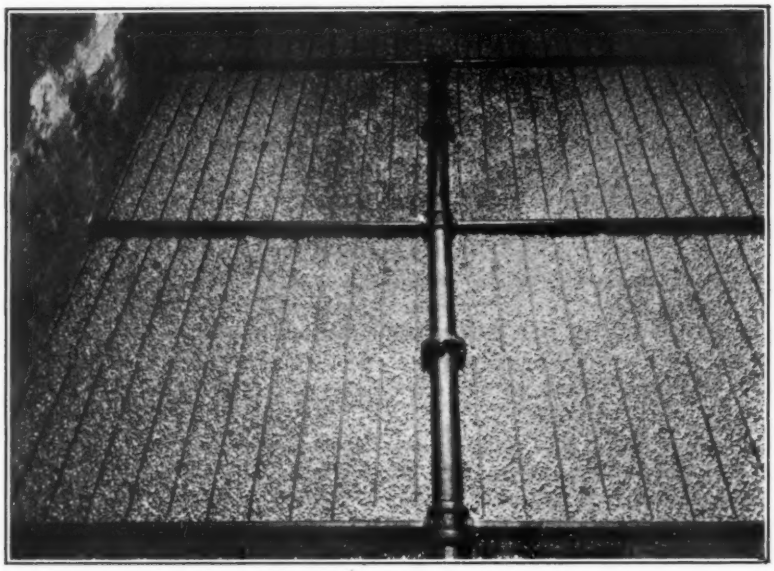


FIGURE 3 *shows the coarse gravel laid on the bottom of the filter and the small, perforated brass pipes thru which air is forced to aid in the process of washing the filter sand.*

feet long, 42 feet wide and 11 feet deep, and is located directly beneath the filters, extending underground 28 feet beyond the end of the filter house. Its available capacity is 200,000 gallons. The suctions of the pumps draw from the south end of this basin.

Alum is used as coagulant in treating the water. The usual dose of alum required is about 0.6 of one grain per gallon, the quantity being varied slightly with the condition of the raw water. Since the water has an alkalinity of from 6 to 8, it is necessary to apply soda ash or lime a large part of the time. The latter seems to give better results.

The chemical solutions are mixed in concrete tanks on the upper story of the building. These tanks are in duplicate. Each of the two alum tanks has a capacity of 3,500 gallons and each of the two soda tanks a capacity of 1,950 gallons. The tanks are fitted with hot and cold water and perforated brass air pipes are provided on the bottoms of each tank for agitating the solutions. From the mixing tanks the solutions flow to the porcelain lined orifice tanks in the laboratory. The level in these orifice tanks is kept constant by float valves, and the outlets, brass needle valves, are adjusted to feed accurately the amount of chemical necessary.

To supplement the filtration process and effect a saving in the amount of alum required, arrangements have been made to apply chlorine to the filtered water whenever it is deemed necessary. The "chloride of lime" solution used for this purpose is mixed in a 6 by 6-foot square concrete tank having a capacity of 1,000 gallons. This tank is located outside of the building in order to prevent the fumes of chlorine from coming in contact with the machinery. One-inch lead pipes lead from this tank to the suctions of each of the two pumps. The partial vacuum produced in the suctions draws the solution into the water as it comes from the clear water basin and the passage thru the pumps thoroly mixes the chlorine solution into the water. Brass needle valves are used to regulate the quantity applied and a water gage on the wall of the pump room shows the level of the water in the solution tank.

The application of chlorine is only nec-

essary when the quality of the raw water is below normal. The dose usually required is about 0.2 of a part of "available chlorine" per million.

To provide for the intelligent operation of the filters, a small laboratory has been installed in the station. Here the quality of the water supplied to the city is carefully watched. Tests for B. coli and bacteriological counts on agar at 37½ degrees C. are made daily on both raw and filtered water. Complete analyses are made at frequent intervals. Daily determinations are also made of the alkalinity of the raw and filtered water to determine the amount of soda or lime necessary for the neutralization of the alum. The turbidity is so slight even after heavy rains that it in no way affects the amount of coagulant required.

As stated above, the soda solution is applied as the water enters the coagulation basin, and the alum a little farther along, after the soda has become mixed with the water by passing several baffles. The alum when it comes in contact with the soda and the calcium and magnesium salts naturally present in the water forms aluminum hydroxide, a sticky gelatinous substance, insoluble in water. A portion of this hydroxide settles to the bottom of the coagulation basin, carrying with it some of the particles of dirt and bacteria in the raw water, but part is carried over to the filters and caught on the top of the sand beds, forming a coat over the surface of the sand thru which the water must pass. This jelly-like covering catches and holds the suspended matter in the water, including the bacteria. When this coat becomes too thick to pass the water at the required rate, the bed is washed and a new coat started. No alum reaches the city mains, as enough soda or lime is always applied to change the alum to aluminum hydroxide, which cannot pass the filters. The calcium and magnesium salts in the water change part of the alum to hydroxide, but the quantity of these salts is so small in the raw water that it is necessary to supplement them with soda ash or lime. The raw water is tested daily to determine the exact amount of soda ash or lime necessary, and as a check the filtered water is also tested daily for traces of alum (lacmoid indicator).

The quantity of chlorine applied is almost infinitesimal, so small that there is no test delicate enough to test it. Prof. Hewlett on the witness stand in a Jersey City case testified that a man would

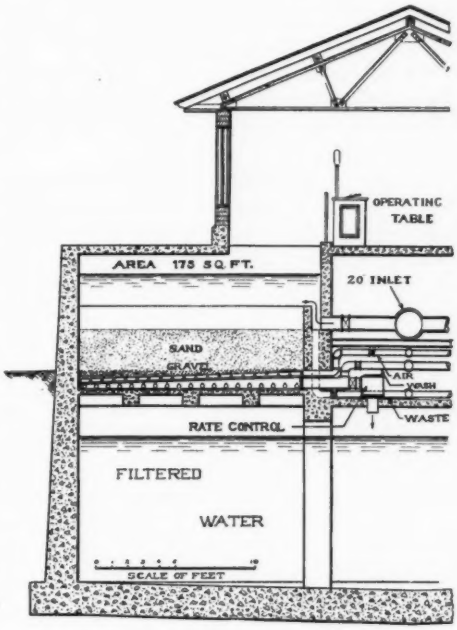


FIGURE 4 *is a cross-section of the filter plant, showing the operating table, above, a cross-section of a filter and of the pipe gallery, below, and the filtered water storage, at the bottom.*

have to drink 2,620,700 gallons to get as much chlorine as is given for an average dose when used as a medicine, when twice as much chloride of lime was used (10 pounds per 1,000,000 gallons) as is used in this plant.

During the first month of operation of the new plant, August 8 to 31, 1913, bacteria to the number of 45 to 180 per cubic centimeter were found in the raw water and 0 to 8 in tap water. Bacillus coli was found in raw water always in 1 centimeter tests and frequently in even 0.1 centimeter. In filtered water it was found five times in the filtered water and once

in 10 cubic centimeters of tap water. Chloride of lime in proportion of 0.3 parts of available chlorine per million gallons was applied to the filtered water.

The fourth figure shows a cross section of half of the filter house. The fifth shows the outside of the pumping and filter plant.

A 5,000,000-gallon Snow pump from the old plant is retained in service, and a new Platt Iron Works pump of 3,000,000 gallons capacity has been installed. Two 125-horse-power water-tube boilers supply steam at 125 pounds pressure.

The water is pumped to the distribution system thru a 16-inch cast iron main running thru the center of the city to the concrete coated reservoir above described, and a new 14-inch main, installed to reinforce the supply to the north end of the city.

The population of Bridgeton is now 14,209. Consumption of water varies from 1,200,000 to 2,200,000 and averages 1,600,000 gallons a day. There are 32.1 miles of distribution mains and 2,978 taps.

Timothy Woodruff was superintendent of the original plant from the beginning in 1877 to January 1, 1913, when he was succeeded by Henry Ryon, who designed the new plant while assistant to Mr. Potts, and to whom we are indebted for information and illustrations.

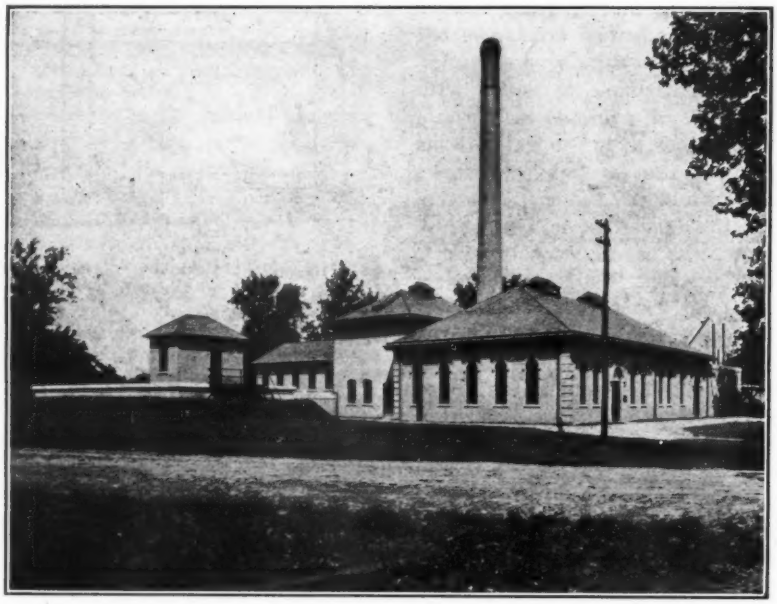
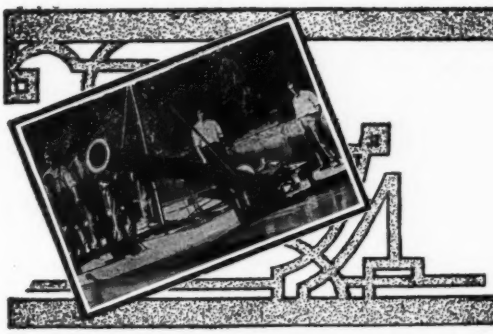


FIGURE 5 *is an exterior view of the buildings of the plant, looking at the corner of the pump room; boiler house and coal storage to the right; filter room to the rear on the left.*



EDITORIAL

A COMPREHENSIVE SEWERAGE PLAN.

One of the most valuable contributions of the most efficient city administration Cincinnati has ever had is the "Report of a Plan of Sewerage," which has just been issued in a book of 730 pages on India paper so that it is a light and convenient book for reading and reference.

The ordinance providing for the preparation of the plan was comprehensive enough to warrant a thoro study of all branches of the subject and the money necessary was appropriated, nearly $150,000, and the result is the report, the letter of transmission of which by Victor T. Price, director of public service, to Henry T. Hunt, mayor, was one of the latest communications of that administration. The report itself is by H. S. Morse, the engineer in charge, and Harrison P. Eddy, consulting engineer, and is made to H. M. Waite, chief engineer of the department of public works, the responsible head of the technical bureau of the department, and it has a number of detailed reports of special investigations by assistant engineers in charge of them, all of which are correlated and coordinated so as to make a complete whole.

This is not the place for a review of the report, but simply for a word of commendation of a great work well done.

A history of the existing sewerage systems, a full underground survey of the city, a topographic survey of the city and its surroundings in full detail, with maps which will be published shortly, general plans for relief sewers for districts which have outgrown present facilities, plans for intercepting sewers and creek improvements, a thoro study of sewage disposal as it may be applied to the local conditions, a detailed description of the organization and statements of cost, each is developed as tho it was the main object of the work.

The various reports contain also the studies made by others which can be used in the work, such as rainfall and run-off statistics, sanitary surveys of various areas tributary, studies of trade wastes, etc., thus bringing into one view all the matters pertinent to the study in hand.

Of the $6,000,000 or so considered necessary to construct the works that are most immediately necessary, some $3,000,000 has been provided by the city council and some of the work is now in progress.

THE BUSINESS OUTLOOK.

Almost all practical business men who discuss the present apparent stagnation in business really attribute it, not to apprehension of "something going to happen," but rather to conservatism. The desire seems to be to do

the business which is at hand and not to expend effort in developing new business, in exploiting new opportunities.

Doubtless much of this is due to unfortunate experiences in exploitations in the past, the ideals having been so much greater than the realities that success was impossible on the scale of development attempted tho it might have been successful on the scale which would be adopted when conservatism is the fashion.

Is not this conservatism really a good thing? Is not the difficulty really imaginary? If we will cut our suits according to the cloth we have will we not in the long run make a better showing than many have been able to make in times of over-production and over-stimulation of business?

The chances for new developments are steadily diminishing in number and our improvements must come in intensive cultivation of the opportunities we have rather than in discounting the future on our ideas of what it may bring forth. That is to say, judicious advertising of the good things we have will be more successful than loud exploitation of things which we hope we may have if our imaginations have not run away with us.

In other words, business is suffering from a state of mind rather than any actual danger.

PROGRESS IN WATER PURIFICATION.

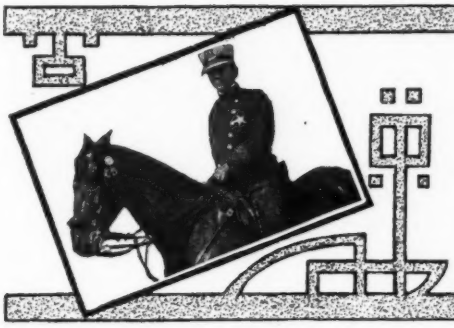
The number of papers and discussions of the subject of water purification which are appearing, some of which are abstracted in this number of MUNICIPAL ENGINEERING, indicates an activity which should result in much benefit to public water supplies. Doubtless much of this activity is due to the introduction into general use in water supplies of the hypochlorite process of sterilization, which is so new in this application as to require considerable experimentation and argument to convince the advocates of the older methods of treatment.

The enthusiasts on the new processes are disposed to go too far and to claim that they can make acceptable drinking water out of any source of supply, tho they will admit that filtration is necessary and that lapses in the accuracy with which the processes are applied will produce dangerous conditions for greater or less lengths of time.

On the other hand, there is a prejudice in the minds of many against a chemical treatment of any kind, which it is difficult to eradicate without evidence from longer experience than is as yet available. Many engineers have joined the procession, however, and chemical methods are popular.

New methods are developed almost yearly and practice varies according to the opportunities of engineers to know the new things and their willingness to accept the experience or the conclusions of others. As a consequence there is more or less fashion in processes and, indeed, in principles of purification of water.

In the face of so many new things it is well to remember that not all of them are as yet fully tested and proved efficient. And it is well to remember that a water supply which is protected from pollution, so that the chances of infection reduced to a minimum, is much more certain to result in a completely sterilized effluent from the purification plant at all times, than one which is known to be seriously polluted at its source and which must depend upon the human fallibility of the operators and the machinery and the judgments exercised in putting this bad water thru its purifying process.



QUESTION DEPARTMENT

Makers of Small Garbage and Refuse Destructors

I have to destroy all the wastes of food, garbage, etc., relating to a hospital. I think it well to have a garbage incineration plant. About 200 persons are supposed to occupy the hospital. If possible, refer me to somebody who will furnish me the specifications and details of that plant. Do you think the garbage incineration plant is the best I can do?
B., ———, Que.

The following firms build such small plants as would be suitable for the conditions stated: Morse-Boulger Company, 39 Cortlandt street, New York; City Wastes Disposal Company, 156 Fifth avenue, New York; William F. Morse, 90 West street, New York; Atkinson-Morse Destructor Company, 628, 30 Church street, New York. Builders of larger plants are The Destructor Company, New York; P. Wylie, Vancouver, B. C.; J. B. Harris, Stahlmann Building, Nashville, Tenn.

Makers of Asphalt Paving Tools and Supplies

We would like to know the names of dealers in asphalt paving equipment and supplies.

What we are interested in is the purchase of asphalt tools, such as rakes, tampers, heating pins and all such classes of equipment.
L., Salt Lake City, Utah.

The principal makers of street asphalt tools are the Barber Asphalt Paving Co., Iroquois Works, 178 Walden Ave., Buffalo, N. Y., and Warren Brothers Company, 59 Temple Place, Boston, Mass. Heating and mixing machinery for asphalt paving materials, portable and stationary, is made by Hetherington and Berner, Indianapolis, Ind., East Iron and Machine Co., Lima, O., The F. D. Cummer and Son Co., Cleveland, O. Heating tank wagons are made by E. D. Etnyre & Co., Oregon, Ill., dryers and heaters for rock and sand by American Process Co., 68 William street, New York; power tampers by Lourie Mfg. Co., Springfield, O., rollers by Erie Machine Shops, Erie, Pa., Kelly-Springfield Road Roller Co., Springfield, O., Buffalo Steam Roller Co., Buffalo, N. Y., Ohio Tractor Mfg. Co., Marion, O., Austin-Western Road Machinery Co., Chicago, Ill., Acme Road Machinery Co., Frankfort, N. Y., as well as the makers of street asphalt tools mentioned above.

Makers of Concrete Molds and Block Machines

Will you please put me in correspondence with some reliable firm that makes molds for porch post columns and block machinery.
F., Middleport, O.

The Besser Manufacturing Company, Alpena, Mich.; U. S. Standard Manufacturing Company, Ashland, Ohio; Sterling Machinery Company, La Crosse, Wis.; C. D. West, Kendallville, Ind.; Zagelmeyer Cast Stone Block Machinery Company, Bay City, Mich.; Simpson Cement Mold Company, Columbus, Ohio; Geo. W. Edgecombe, Benton Harbor, Mich., are prominent makers of the machinery and molds desired.

Success of Garbage Incinerators

Could you cite me to any data of value in regard to the operation and success of garbage incinerators?
City Manager, ———, Ariz.

Morse's book on "The Collection and Disposal of Municipal Waste" ($5) gives a full history of the successes and failures in garbage and refuse disposal. Venable's "Garbage Crematories in America" ($2) gives a full list of American patents and styles of furnaces. Parsons" "Muncipal Disposal of Refuse" ($2) is mainly devoted to the methods and results of the New York City system. Most of the successful plants of recent years and some not so successful have been described in more or less detail in MUNICIPAL ENGINEERING, the latest articles being "Garbage Disposal at Erie, Pa., in vol. xlvi, p. 481; "Garbage Reduction by the Hirsh Process," p. 390; "Garbage Disposal for Small City," p. 237, giving a list of the more important articles in earlier numbers.

Voids in Crushed Stone

Can you refer me to any articles or books which treat upon the voids in various sizes of crushed stone? I have been making some experiments which do not seem to bear out the tables given in Taylor & Thompson's "Plain and Reinforced Concrete."

W., ———, Iowa.

Any assistance our readers can give will be appreciated by our correspondent. Articles on filtration, more particularly of sewage, reports of experiments on sewage and water filtration, such as those of Columbus, Ohio, articles on specifications for macadam and asphalt macadam pavements, such as the one by Mr. Blanchard, abstracted elsewhere in this number, may be of interest, as well as those on concrete, such as given in Sabin's "Cement and Concrete," Blanchard's "Highway Engineering" and in proceedings of the American Concrete Institute.

Books on Architectural Drawing, Designing and Specifications

Will you please tell me where I can get a book or books on architectural draughting, designing and specifications.

D., Norfolk, Va.

The catalog of architectural, scientific, industrial and technical books issued by the William T. Comstock Company, 23 Warren street, New York City, contains long lists of books on the subjects named, each with a brief description of the contents, from which selection can be made. A copy of the catalog can be obtained on application to the Comstock Company.

Municipal Improvements Without Bond Issues

Are there any cities in the United States that have carried through their city improvements without the issuance of bonds, and, if there are such cities, by what means the necessary money has been raised?

So far as I know, the small town of Aledo, Ill., is the only municipality in the United States that can boast of this record.

K. M., New York City.

If the issuance of municipal bonds for paying for street, sewer, sidewalk and other municipal improvements is intended to be covered, scarcely any cities in Indiana have issued bonds of the city for such purposes. In most cases bonds have been issued, called "Barrett Law Bonds," from the name of the author of the original law, for which the city assumes no liability, but they are liens directly upon the property upon which the assessments for the improvements were made and run for ten years, one-tenth being due each year.

Omitting indebtedness for buildings, city hall, police and fire departments, parks and schools, the following cities are reported in Table 30 of the "Financial Statistics of Cities for 1911," as having no indebtedness for sewer, streets, bridges and the like improvements: Washington, D. C.; Indianapolis, Ind. ($95,000 bridge bonds); Des Moines, Iowa; Evansville, Ind.; Fort Wayne, Ind.; Berkeley, Cal.; Davenport, Iowa; Tampa, Fla.; Augusta, Ga.; Dubuque, Iowa; Springfield, Mo.; Quincy, Ill.; Austin, Tex.; Council Bluffs, Iowa.

The Indiana and Iowa cities take care of these improvements as above stated by special assessment bonds of short term and not city obligations.

Who Produces Novaculite?

We would like to have the address of companies or firms producing crushed stone for macadam known as "Novaculite.

About ten years ago a mile of road in this city was improved by applying novaculite, which, I believe, was secured from producers who had a quarry in Southern Illinois not far from Chester.

D. D., ———, Ill.

Can our readers supply the desired information? Quarries of novaculite exist near Cairo, Ill., in Missouri and Arkansas and a stone of similar nature is found near Lafayette, Ind. Some years ago it was reported that the only firm handling novaculite commercially was the Novaculite Paving Company, Equitable Building, St. Louis, Mo., but there may be others now.

Ordinances Abating Nuisances

Will you please send forms of ordinances for removing nuisances from private property and assessing cost to owner?

F., Lincoln, Neb.

Ordinances governing signs and billboards are given in MUNICIPAL ENGINEERING, vol. xlii, p. 249. Provisions of ordinances regulating weed cutting and refuse removal are outlined in vol. xliii, p. 254, and a little more fully in vol. xliv, p. 425.

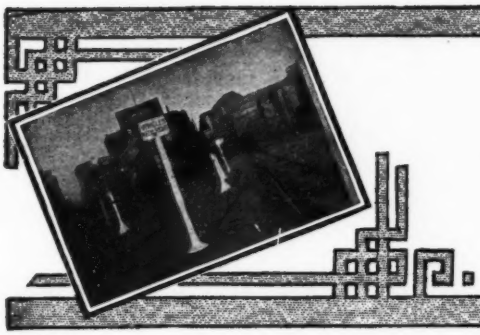
Form of Water Meter Record

Will you kindly refer us to some firm that makes up different styles of meter reading books? We wish to keep a good record of our water meter readings and wish to have an up to date system of bookkeeping.

J. C. G., ———, S. D.

A form of office record of meter readings is given in MUNICIPAL ENGINEERING, vol. xlii, p. 251, with some suggestions of improvements that could be made in it. In vol. xliv, p. 233, is a full description of what a meter reading book should be and instructions for making one are given. On p. 522 of the same volume is a form of meter record for an electric current which could easily be modified for a water meter record.

The Buffalo Meter Company, Buffalo, N. Y., prints a form of water meter record.



WORKERS IN THE FIELD

A Word For the Much Abused Septic Tank

The Editor of MUNICIPAL ENGINEERING:

Sir—In considering the efficiency or otherwise of the septic tank, it too frequently happens that municipal authorities and others are influenced by the opinions of those whose experience has been limited to experimental tanks in which, for various reasons, no attention has been paid to well established principles.

It is unfortunately true, also, that absurd claims have been made as to the possibilities of the septic tank, some having gone so far as to state seriously that tanks of their design will produce a perfectly pure effluent without subsequent treatment, and when later it is found that these promises are not fulfilled, it is the septic tank that is discredited, and not its designer.

The septic process is divided into two stages—the anerobic or putrefaction stage, which takes place in the septic tank, and the aerobic or nitrifying stage, which takes place when the effluent from the septic tank is exposed to air and light. When an effluent is to be discharged into a relatively large body of running water, it is often quite permissible to rely on the septic tank alone for a sufficient degree of purification, but when, as often happens, it is to be discharged into a ditch or small stream, liable to run dry during the hot summer months, it is necessary to subject the tank effluent to some form of subsequent treatment, either in contact beds, filters or otherwise. The character and extent of this subsequent treatment will, of course, be governed by local conditions in each case.

The reasons for the failure of so many so-called septic tanks are numerous. In some, possibly to economize on the cost of construction, the rest period has been reduced to 6, 8 or 10 hours, instead of adhering to a 16 or 24-hour basis. This prevents the development of septic action, because, before it is established, the tank fills up with solids and smells badly; hence the necessity for frequent cleaning and the existence of bad odors, which are entirely unnecessary.

These short-period tanks are mere catch basins or cesspools, in which only the heavier solids are retained, and it follows that the relatively rapid flow of sewage thru them carries away the anaerobic menstruum which is relied on for complete liquefaction; this, too, is often emphasized by defective inlet and outlet arrangements.

Instead of extending the inlet and outlet openings across the entire width of the tank, at mid-depth, they are frequently constructed with one or two pipe openings; these naturally create currents thru the tank and result in dead corners where the sewage lies stagnant. This stagnation, aside from having a detrimental effect on the micro-organisms that are being developed, wastes space that in a properly designed septic tank is effectively utilized.

In some cases the outlet consists of a weir overflow, using a baffle wall extending from above the surface down to within a foot or two of the bottom to keep back the scum. The flow of sewage is thus directed downward and the solids at the bottom are disturbed to such an extent that as the putrefactive or liquefying process goes on, the flocculent matter, or partially dissolved solids, are swept out of the tank and make trouble, for all of which the septic tank is blamed. Such an arrangement of the outlet would be bad enough if the tank were otherwise correctly proportioned, but is disastrous with a tank whose rest-period is too short anyway.

In conclusion, it is not too much to say that no septic tank which is properly designed with due regard to the character and volume of the sewage to be treated, and in which the fundamental principles of the septic process are correctly applied, will fail to operate successfully and do all that can be reasonably claimed for it, and, further, that such an installation is not only the most economical in

first cost and operating expense, but the most efficient method of sewage disposal that is known today.

H. D. WYLLIE, Sanitary Engineer,
Chicago, Ill.

Sewer Under Railroad Track

In the construction of a sewer under the four Grand Trunk railroad tracks at Richfield road and Avon street, in Flint, Mich., the railroad engineer permitted the contractor, Albert H. Prange, to use vitrified clay segment blocks instead of 27-in. cast iron pipe. This made it possible to lay the sewer in tunnel, 6 inches of concrete being laid around the sewer, the same as was required by the specifications for the cast iron pipe construction. R. W. Stoddard, the engineer for the contractor, reports the length of the tunnel 64 feet, width 5 feet and height 6 feet. A shaft 5 feet square was sunk in the center of the four tracks and the tunnel was worked both ways from it. As soon as the end of the sewer was reached the blocks were laid, no time being lost in enlarging to admit long pipes or large diameters, and no derricks or rollers being necessary or space to pour lead joints.

The tunneling required 180 hours of workmen's time, laying the blocks 20 hours, placing concrete 20 hours, backfill 40 hours.

Removal of Snow From Street Railway Tracks

Some extracts from a paper by Martin Schreiber, maintenance of way engineer of the Public Service Railway Company, operating between Jersey City and Camden, N. J., in some 140 municipalities, read at the recent snow-removal conference in Philadelphia, show the advantages of thoro preliminary organization in getting to work and the necessity of planning as nearly as may be the order of abandonment of lines when the storm is too severe for the organization to cope with.

No special supervisory organization is required in handling snow, only the regular force of employes is enlarged. Early in the fall the various departmental heads and their assistants, including the superintendents of transportation, maintenance of way, distribution and equipment meet and lay out a co-ordinate plan of action. The transportation department, thru the division superintendents and supervisors at the various car houses, assigns certain crews to operate the snow fighting apparatus, such as plows, sweepers and levelers. The names of the crews, with their addresses, are posted in each car house in advance, so that they may be called on at a moment's notice.

Likewise, the equipment department, thru the division master mechanics and car house foremen, selects the proper mechanical men to accompany the snow-fighting equipment and others to look after repairs continuously thru the period of the snow storm.

The maintenance of way department, thru the division roadmasters and section foremen, also records the addresses of a large number of emergency men and teams, who may be quickly assembled at anticipated locations.

At the preliminary meeting of the heads of departments the various locations are decided on where snow must first be cleared away, such as intersections, curves and crosswalks, so that the track foremen may begin operation at the most important places, and follow up at other locations in a consecutive order.

The distribution department also keeps in close touch with all the plans so that they may decide in advance how to increase the power on particular lines by switching in and out feeders, in order to take care of the heavy drain on the distribution system that is caused by the operation of the plows and sweepers. Besides, they arrange to have extra emergency crews at certain locations to take care of line breaks.

Along with the definite organization scheme, the snow equipment is carefully inspected and all necessary repairs are made to the snow plows, sweepers and levelers during the summer, so that the entire apparatus is in first-class condition.

The equipment consists of 76 snow sweepers, 21 shear plows, 2 rotary plows and 7 work cars equipped with levelers. A careful inspection is made of the railway strip to make sure that no paving stones, crossing planks or other obstructions exist which would interfere with the operation of the plows and sweepers. Sewer manholes and dumps are selected which will be the most economical and satisfactory to the city, and means of access to these places by the trucks are also planned.

All of the plows and sweepers which have been assigned to particular trackage are actually operated on these lines on trial trips, and all troubles which are possible to eliminate are promptly remedied.

As soon as a storm sets in, all of the departments marshal their crews and extra men at the various yards and car houses in each division. Ordinarily one trackman inspects ten miles of track. During a storm at least six men are kept busy, cleaning switches and special work on a section of this length. The crews for the plows and sweepers are kept on

waiting orders at full pay, so that no time will be lost in getting into action. As soon as the snow reaches about 2 inches the sweepers are brought out and operated continuously during the entire storm. Telephone communications are established and the transportation department assigns a man to keep hourly records of the location of the regular operation on the 111 lines of the system.

Snow collected on the sides of the tracks thru the operation of plows and sweepers over the roadway is forced away from the tracks (if the storm continues) by means of levelers attached to the sides of the sweepers and plows, or special work cars. Depending on the severity of the storm, two or more track laborers are assigned to each plow or sweeper for the purpose of digging out snow and ice with hand shovels wherever drifts are encountered. The rotary plows are reserved for handling the extra heavy drifts, which occur more frequently in outlying districts or on suburban lines.

When the snow begins to collect faster than it can be handled with the snow removing apparatus, the outlying lines are abandoned first and the apparatus is concentrated on the city service. During the last storms the company had a number of cars which were snowed in for 24 hours. This was caused by broken down telegraph and telephone lines crossing lighting and trolley circuits, introducing a great source of danger, so that the power had to be shut off. With the power off, the snow was quickly packed around the cars and they could not be moved until actually dug out by hand labor.

As soon as the storm is over, or, in fact, as soon as the snow is piled in any quantities along the side of the tracks, the work of removing it is started. The largest part is hauled away by teams and dumped into sewers, rivers or meadows; in one city a great quantity was dumped into a canal. Considerable progress has been made in hauling away snow in some cities by avoiding conflicting organizations working on the same street at the same time. Definite schedules are mapped out so that the railway company removed all the snow on certain highways between building lines, and the city all the snow on other streets. Some municipalities remove all the snow themselves and the railway company is billed for their portion of the cost on streets where tracks are constructed. One of the customs of the company is to follow up the men on snow removal with special provision cars, so that the men are supplied with hot coffee and sandwiches, all of which has been greatly appreciated by the employes.

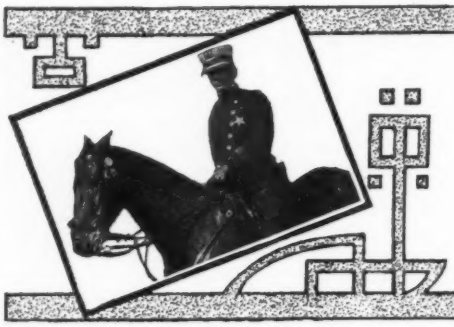
It is doubtful, under present conditions, if it is practical for the railway company to make many more improvements for cleaning track and roadway of snow. Of course, there is always room for improvements by strict planning, inspection and supervision of the work. One of the most unfortunate conditions surrounding the handling of snow by the railway company or municipality is the fact that the apparatus is idle such a large portion of its existence. The possibility of the mechanical equipment being out of commission so long a time will always be the cause of strong argument against the development of any special machine for melting or removing snow.

It appears that about the only way to efficiently remove snow is thru further co-operation of the railway company and municipality—for example, stations and dumps could be established and the railway company contract with the municipality for hauling all the garbage and refuse. So, in the winter, in case it was required to haul snow, all the equipment for garbage, including the stations and dumps, could be pressed into service for disposal of the snow, without any extra investment expense.

Another plan would be to design streets and roadways with special gutters equipped with flushing apparatus, which could be used for cleaning and draining streets as well as getting rid of the snow.

Automatic Street Lighting in Leeds

Leeds, England, has been experimenting with automatic lamp-lighting installations, and they have proved so successful that it is proposed to have the City Council apply to the Local Government Board for sanction to borrow $112,000 to equip the 17,000 gas lamps which help light the city. Two systems have been considered and preference has been given to the adjustable clock over the wave-pressure system. It is estimated that 77 men at 28s. 6d. ($6.93) per week can be dispensed with, which means an annual saving of about $28,000. It has been shown that failures in lights by the clock system are only 23 in 10,000, and these can be adjusted by inspection. It is claimed that by the automatic system there is an enormous saving in mantles, and the authorities of Newcastle are reported to estimate that by this system there is an all-around saving of nearly 20 per cent.



LEGAL DECISIONS

Decisions of the Higher Courts of Interest to Municipalities

Inequality in Sidewalk—In a city requiring property owners to provide a sidewalk in front of their premises at their sole expense, a difference in level ranging from 2 to 2½ inches, but which, by the accumulation of dirt on the lower sidewalk, had been reduced to an average of 1½ inches, and where the higher sidewalk did not end abruptly, but began 1½ inches from the dividing line, and sloped at an angle of 45 degrees toward the lower sidewalk, was not such an inequality as to make the city guilty of negligence, and liable to one injured by stumbling over it in daylight. The duty of municipal corporations is to see that their sidewalks are in reasonably safe condition for persons exercising ordinary care and prudence. Goodwyn v. City of Shreveport (La.), 64 S. R., 762.

Damages for Removal of Shade Trees—A municipality may remove shade trees from a street without being liable to abutting owners for resulting damages if their removal was reasonably necessary to improve the highway, but is liable therefor if their removal was unnecessary and arbitrary. Town of Durant (Miss.) v. Castleberry et ux., 64 S. R., 657.

Towns Cannot Issue Bonds for Improvements Already Paid for by Taxation.—St. 1907, c. 476, providing that the town of Lincoln may issue bonds for the extension of its waterworks did not authorize the town to issue bonds to reimburse it for extensions already paid for by taxation, so as to keep the waterworks' finances separate; the town being a single municipal entity, of which one department could not become the debtor. Chapin v. Town of Lincoln, Mass. 104, N. E. R. 745.

Damages for Nuisance and Damage from Overflow Occasioned by Storm Sewer.—Where the sewerage system of a city drained into a natural water course, and covered the land of a lower riparian owner with foul and offensive deposits, the city was liable in damages for a nuisance, notwithstanding the acts of third parties in filling in the channel of the stream below, which also contributed to the result. Where a city by its sewerage system intercepted water which would naturally have drained below plaintiff's land and discharged it into the stream above such land, it was liable for damages caused by an overflow on such land, tho the natural channel was sufficient to accommodate all such drainage and was rendered insufficient by lower riparian owners filling in their land below. Judd v. City of New Britain (Conn.), 90 Atl. R., 35.

Sewage Disposal Company Liable for Nuisance from Defective Operation.—The fact that a sewage disposal company is chartered by the state to perform a public service, and that its duties are exercised under the direction of the State Board of Health, and that its plant was constructed under plans approved by the State Drainage Commission, would not relieve it from criminal responsibility for maintaining a nuisance by the faulty construction or operation of its plant. In a prosecution for maintaining a sewage disposal plant so as to constitute a nuisance, evidence of the cost of the plant and that it was not profitable was not relevant. In a prosecution for maintaining a nuisance, caused by the negligent construction and operation of defendant's sewage disposal plant, evidence that sewage could be treated near dwellings without offense was admissible to show that the noxious odors from defendant's plant could be eliminated by proper construction and operation. State v. Collingswood Sewerage Co. (N. J.), 89 Atl. R., 525.

When Water Company Is Liable for Fire Damage Loss from Defective Hydrants.—Where a water company has contracted with a city to furnish a sufficient water supply for the protection of the inhabitants against fire, the company is liable in damages to a property owner for fire loss resulting from its failure or refusal to perform such contract; but a citizen's right is measured by the duties imposed on the water company by the contract itself, and no recovery can be had, unless it appears that the water

company's failure to comply with some provision of the contract was the proximate cause of the loss.

A franchise authorized defendant private water company to furnish water to the city and its inhabitants provided that defendant should "furnish and set" 100 fire hydrants of modern pattern and good efficiency, that the hydrants should be rented by the city for five years; the city agreeing to use them carefully, and pay for any injury that might happen to them by any officer or servant of the city or member of its fire department. The contract further provided that the hydrants should be used only to extinguish fires and flush gutters and sewers, that the chief of the fire department should have control of them, should cause them to be inspected, and if, on inspection, any were found out of working order, defendant should be notified in writing, and was required to put such hydrants in effective working order with reasonable dispatch. *Held*, that the word "furnish" as applied to the duty to provide hydrants meant "provide at its own expense," and did not require the company, at its peril, to keep the hydrants constantly in working condition so as to render it liable to a citizen for a fire loss due to a hydrant being out of repair, without any notice having been given defendant thereof. Tobin v. Frankfort Water Co. (Ky.), 164 S. W. R., 956.

Damages for Grading Street.—A purchaser of property purchases with the implied consent that the street must be made reasonably safe and convenient for travel, and cannot complain that it is lowered or filled to make it safe for travel, so long as the city has established a grade so as to inform him of the extent to which it would be lowered or raised. In reducing inequalities in streets by changing the grade, more latitude should be allowed to large cities than to the smaller cities or country towns; paving being a necessity in the larger cities. Gray et al. v. Salt Lake City (Utah), 138 Pac., 1177.

Free Water for Street Sprinkling.—Where a city employs a street railway company to sprinkle its streets, it may delegate to such company its right, under a contract with a water company, to take water from hydrants for use in sprinkling streets where the contract with the water company contains no restriction, even by implication, as to the method of putting the water on the streets. City of New Castle Water Co. v. Mahoning & S. Ry. & Light Co. (Pa.), 89 Atl. R., 811.

City Not Liable for Damage from Broken Water Main.—A city is not an insurer of its water system, but is required only to use reasonable care in establishing and maintaining it, and hence was not liable for the flooding of a cellar through the bursting of a water pipe, in the absence of any negligence in its construction or operation, or in the repair thereof after notice of the break, or actual notice by like prior occurrences that the pipe was defectively constructed or maintained. Simon v. City of New York (N. Y.3, 143 N. Y. Supp., 1097.

Franchise for Trolley Line

Waterford, Pa., has granted the Erie Southern Railway Company the right to construct a trolley line thru the boro. This is an interurban line running south from Erie, Pa., which is at work securing franchises and rights of way and making surveys for construction as soon as the way is clear therefor.

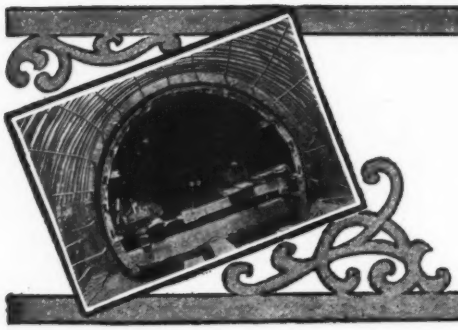
Concrete Reservoir at Latrobe, Pa.

The Latrobe Water Company has recently completed a new filtration plant near Kingston station, Pa., having a sedimentation basin 120 by 120 by 10 feet and a coagulating basin 120 by 85 by 14 feet, with walls and floors of reinforced concrete. Crushed Ligonier stone, Ligonier stone dust instead of sand, and Universal portland cement were used in proportions to make the densest concrete possible. When the forms were removed the inside surfaces were washed and plastered with a mixture of cement and stone dust. As an additional precaution the bottom of the reservoir has a layer of 4-ply paper and asphaltum. The result is satisfactory as to water-tightness.

The site being 250 feet above the railroad track, an inclined tramway was built up the hill from the railroad siding. Stone cars were unloaded by gravity into the Koppel tramway cars, which were hauled up the incline by a hoisting engine at the top of the hill. From this point the cars were run partly by gravity and partly by a mule team to the location of the concrete mixing plant, which was changed as required. This arrangement reduced the stone-handling gang to three men and the team, one to load cars below, one to run the hoisting engine and one to unload at the top.

Grade Crossings in Iowa

The State Highway Commission of Iowa is receiving the co-operation of the railroads in relieving the dangers of grade crossings, and plans are being made for eliminating the most dangerous, Page County being the first on attacked. No new grade crossings of railroads are permitted, and a recent problem in Woodward of the crossing of an interurban and the Milwaukee road was settled by dividing the expense of an overhead crossing by the interurban between the two roads.



SANITATION

Sewage Purification for Akron, O.

The City of Akron, Ohio, discharges its sewage into the Cuyahoga River, which later flows thru Cleveland into Lake Erie. On account of complaint concerning the deleterious effect of the sewage on the river, the city instituted a series of tests to determine the best method of treating the sewage of the city to produce a satisfactory effluent.

A testing station was erected on the recommendation of E. G. Bradbury, the engineer engaged to report upon the most practical and economical method of solving the sewage disposal problem, and Harry B. Hommon was put in charge of the experiments, with sufficient force of assistants. Grit chambers, Imhoff, Dortmund and septic tanks, sprinkling filters and contact filters were all provided and operated singly and in appropriate combinations.

Special observations and tests were made of the trade wastes from the rubber, salt, rubber reclaiming and paper manufacturing plants discharging into the sewers or directly into the river, and in general it was decided that there was little or no deleterious effect upon the river and no probability of interference of such wastes with any process of sewage purification tested.

The results of the tests have been printed in detail in a report by Mr. Hommon and the final conclusions as to the best method of treatment are stated as follows:

These tests have clearly shown that the sewage of the city of Akron can be successfully purified at a plant which would comprise:

1. A small grit chamber for the removal of sand.

2. Imhoff tanks of a capacity equivalent to a period of flow of about 2.5 hours, and sludge beds corresponding to an average net accumulation of about 1.4 tons of dry solids per million gallons. (Drying period—July 1st to November 1st.)

3. Sprinkling filters operated at the rate of 2,000,000 gallons per acre in 24 hours, and small settling basins of about 2 hours' flow, with ample means for the withdrawal of sludge.

4. Adequate means for the disposal of an accumulation in the settling basins of about 0.5 tons of dry solid matter per million gallons.

The evidence is conclusive that such a plant would purify the sewage of Akron in a most thoro manner, and under continued proper operation and efficient supervision would prevent all visible contamination of the Cuyahoga River below the outlet of the Akron sewers.

Separate and Combined Sewers in Their Relation to the Disposal of Sewers.

By John H. Gregory, Consulting Engineer, New York City.

In his paper before the American Society of Municipal Improvements of which this is an abstract, Mr. Gregory, who is a member of the firm of Hering and Gregory, has clearly stated the principles upon which the design of sewers and disposal of sewage should be based, and it is an authoritative chapter upon this subject.

In the construction of a new sewerage system, or of new sewers, one of the problems which first arises is the question shall the sewers be built on the combined system, or partly on both. Two factors of the greatest importance are the questions of cost and of sewage disposal.

As a general proposition, where both sewage and storm water are to be removed it is probably safe to say that the cost of building a combined system is less than that of constructing a separate system, in which the sewage flows in one set, called sanitary sewers, and the storm water in another set, called storm water drains. This is especially true where the territory is more or less closely built up and the streets are paved. But in territory, not closely built up nor likely to be in the near future, and

where the storm water is easily diverted into natural water courses, the separate system will in general cost less, for the sanitary sewers may be built first, the storm water drains being deferred, or only such drains built as are immediately required.

¶ COMBINED SEWERS *are advisable in many instances with the advantages here set forth.*

The character of the topography should not be overlooked. With steep grades and relatively high velocities in the sewers it might prove more advisable, on account of the relatively small additional cost, to build combined rather than separate sewers. In narrow streets and in congested districts combined sewers have one advantage by reducing the subsurface obstructions. With the separate system two pipes are required, and sometimes three, when a sanitary sewer is laid on each side of a storm water drain, built so close to the surface of the street as to prevent the carrying of house connections over it.

With the combined system, but one house connection is needed, whereas with the separate system, especially in closely built up districts with paved yards and areas, two are required, one for the removal of the sewage and the other of storm water from roofs, paved areas, etc. The practice of discharging storm water across the sidewalks to the gutters is not one to be recommended. The storm water is, however, sometimes removed by pipes laid just below the surface of the sidewalk and discharging at the gutter. Such pipes frequently give trouble, and often would not be low enough to drain paved areas adjacent to or in the rear of buildings.

Combined sewers are generally laid on flatter grades than separate sewers and may increase the area which can be served without pumping. They may even eliminate pumping entirely. It sometimes happens that combined sewers can be advantageously adopted for a part of the system and separate sewers for the remainder. The writer has in mind one of the large cities in the east where no pumping is required and in which three-quarters of the city is sewered on the separate system and one-quarter on the combined system because it was too low to be sewered on the separate system without pumping.

Higher velocities are required in combined sewers in order to prevent the deposition of grit. When deposits occur in combined sewers organic matter is likely to be held back and settle out or become stranded and may cause the sewage to be ponded and become stale, or possibly septic, a condition to be avoided, independent of whether the sewage is to be treated or not.

¶ THE QUESTION OF SEWAGE DISPOSAL *is of great importance where economy is essential.*

So far the subject has been considered without reference to the question of sewage disposal, one of the most important factors. If the sewage is to be discharged into a body of water without treatment, combined sewers would frequently offer the simplest and cheapest solution of the problem. If, however, the sewage is to be treated, separate sewers have certain advantages. It will be assumed here that the sewage must receive some treatment and that ample opportunity is afforded for the discharge of storm water without carrying any great distance.

Sewage treatment works cost money. It is therefore desirable to keep them as small as possible. Rarely, if ever, would all of the storm water have to be treated; hence the question of treating other than the first wash of the streets, in addition to the sewage, will not be considered.

With a separate system the volume to be handled at the treatment works is made up of house sewage, ground-water leakage and trade wastes. The flow may be increased in times of storm by taking in the first wash of the streets from the storm water drains should it be found necessary or desirable to treat the first wash.

With a combined system, under dry weather conditions, the volume to be handled ordinarily is also made up of house sewage, ground-water leakage and trade wastes. In times of storm, however, the flow in the combined sewers is increased by the storm water from the streets, which changes the character of the liquid flowing. The first wash from the streets is often exceedingly foul and may give a stronger sewage. As more storm water enters the organic content of the liquid is decreased, resulting in a weak or dilute sewage.

If only the dry weather flow is to be intercepted, then the volume to be handled at the treatment works would, in general, be substantially the same from the combined system as from the separate system. With the separate system no raw sewage escapes to the streams, while with the combined system a mixture of sewage and storm water must reach the streams.

It probably often would be the case, that as far as the temporary reduction of dissolved oxygen in the stream is concerned no harm would be done, but float-

ing particles of paper and fecal matter are offensive to the sight. If the stream is sluggish it may easily be that the continued overflow of sewage into it, from time to time, with the accumulation of sludge deposits on the bottom, would lead to offensive conditions.

While considering the question of the overflow of raw sewage from combined sewers the point of view of the public should not be overlooked. They know that the sewage must be treated and their natural inference is that all of the sewage will be treated. But if the sewers are built on the combined system and the public sees raw sewage, even if dilute, discharged into the streams from time to time will they be satisfied? And will the state authorities be satisfied?

¶ INTERCEPTION OF EARLY STORM WATER *essential to satisfy observers who see sewage overflowing with storm water into stream.*

In order to reduce the number of times during the year that raw sewage would overflow, it might be planned to intercept some storm water as well as the dry weather flow. This would increase the size of the sewage treatment works, and their cost.

If it is found desirable or necessary to intercept and treat the first wash from the streets, the separate system is more advantageous than the combined system, as by its adoption no overflow of raw sewage to the streams will take place. The storm water drains receive only storm water and the first wash from the streets can be intercepted in the storm water drains and discharged either into the sanitary sewers, or into the intercepting sewer leading to the treatment works. As the flow in the storm water drains increases, the surplus water overflows to the streams but carries no sewage with it.

¶ SEPARATE SYSTEM MORE FLEXIBLE *in disposing of trade wastes, many of which are rather inoffensive.*

The separate system, under certain conditions, offers greater flexibility in the disposal of trade wastes than does the combined system, unless the first wash of the streets is to be intercepted and treated. Some trade wastes are offensive and if discharged into the sewers in such a condition must be treated. Some are inoffensive and can be discharged directly into the streams without causing any nuisance or trouble.

With the separate system the offensive trade wastes can be discharged into the sanitary sewers and the inoffensive wastes into the storm water drains. The offensive trade wastes only would then be carried to the treatment works. With the combined system all of the trade wastes, the inoffensive as well as the offensive ones, would have to be intercepted and carried to the treatment works, with the result that the treatment works would have to be somewhat larger in size, and hence would cost more.

With a community which is largely residential in character the volume of trade wastes would affect but very little the total sewage flow. With a manufacturing community, however, the trade waste might amount to quite a large percentage of the total flow and in extreme cases might equal in volume the house sewage. Under such conditions it is evident that, if any considerable percentage of the trade wastes is inoffensive, separate sewers would be of decided advantage as they would permit of the inoffensive wastes being discharged direct into the storm water drains.

With a combined system automatic regulators are generally used on the connections between the combined sewers and the intercepting sewer to limit the amount of flow from the combined sewers to the intercepting sewer. With a separate system automatic regulators are not required unless the first wash from the streets is intercepted in the storm water drains. Automatic devices in sewers, as a general proposition, no matter how well designed, are to be avoided wherever possible.

The presence of grit at a sewage disposal works is generally more or less of an annoyance, especially when the sewage has to be pumped and passed thru settling tanks. With combined sewers, receiving as they do storm water from the streets, a considerable amount of grit must be expected to reach the disposal works, not only during wet weather but during dry weather also. With separate sewers the amount of grit received at the disposal works is relatively small unless the first wash from the streets is intercepted in the storm water drains and carried to the disposal works.

It has been suggested that a considerable amount of grit could be prevented from reaching the disposal works from combined sewers by inserting a catch basin or sand catcher on each connection between the combined sewers and the intercepting sewer. It is probably true that such would be the case but it is a question whether this would be a good method of removing grit. In the first place these sand catchers would sooner or later fill up and unless cleaned at

proper intervals would fail to serve the purpose for which they were built. Again, it is very probable that more or less organic matter would be deposited in them, especially when only the dry weather flow, consisting as it would mainly of sewage, was passing thru them.

The inserting of sand catchers between storm water drains and an intercepting sewer would seem to be a more practicable proposition. They would still have to be cleaned to make them effective.

¶ SAND-CATCHERS *in sewers before sewage enters intercepter are often best way to keep grit out of system.*

It is a question if the simplest way of handling the grit is not to admit it into the intercepting sewer from the combined sewers or storm water drains, without attempting to intercept any portion of it, and then to transport it with a good velocity in the intercepting sewer direct to the sewage disposal works. In any event enough grit is sure to reach the sewage disposal works to require its removal before the sewage is pumped or passed thru settling tanks, and the removal of grit at one point instead of at numerous points has many advantages.

With sewage from a combined system the volume of sludge accumulating in settling tanks is greater than with sewage from the separate system. It may even be nearly twice as much, as has been found to be the case by comparison of the quantities of digested sludge removed from different Imhoff tanks, some of which have been connected with combined systems and others with separate systems. The greater volume of sludge from the combined system may mean that less organic matter has reached the streams than would have been the case if the sewers had been built on the separate system. If, however, the first wash from the storm water drains of a separate system is intercepted and carried to the treatment works then the volume of sludge should be approximately the same as if the sewage came from a combined system.

¶ WHEN SEWAGE MUST BE PUMPED *economy requires that the least possible amount of storm water be pumped, tho the lift would probably be less in combined system.*

In many instances pumping is required in order to pass sewage thru a treatment works. It may even be that the sewage would be delivered at an elevation below that of the stream into which the effluent was to be discharged.

With a combined system the total height to which the sewage would have to be pumped would probably be somewhat less than with a separate system, but the difference would not be great. Some saving in fuel might therefore result from the adoption of the combined system, but the same operating force would be required in either case. So long as pumping is required the actual saving in cost due to pumping the sewage against a less head, due to the adoption of the combined system, would be slight compared with the total cost of pumping, including fixed charges.

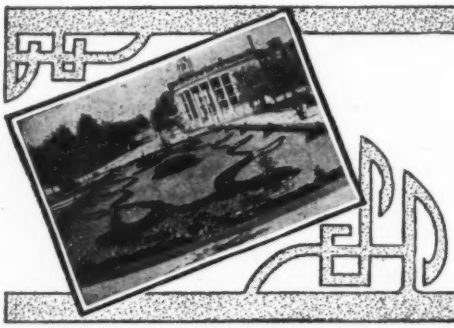
In conclusion no hard or fast rules can be given for the adoption of either the combined or the separate system. Each has certain advantages. These, as well as local conditions and cost of construction and operation, must be taken into account. Other things being equal, especially as more attention is being given to the question of sewage disposal, the separate system seems to offer greater advantages. With either system, however, to secure satisfactory results too much stress cannot be laid on the necessity of not only proper design, but satisfactory maintenance and operation.

New York Opposition to Passaic Valley Sewerage Plans

The clerk of the New York Supreme Court has demanded of the City of New York the advance payment of $18,175 for printing and court fees before it can appear to argue the suit against the Passaic Valley Sewerage Commission's plans for a trunk sewer emptying into New York harbor. There will be additional expenses carrying the amount to $26,000, and it is possible the new administration will not continue the fight.

Concrete Road Construction About Detroit, Mich.

The Wayne County road commissioners at Detroit, Mich., have made plans and specifications and are letting contracts for more concrete roads. The seven-mile road will be completed from Mack to Woodward. The old macadam on Grand River road will be replaced by concrete. Dix road will be concreted to the new bascule bridge over the River Rouge. Eureka road will be concreted for 6½ miles, completing it from Romulus to Wyandotte. West road will be concreted for 5 miles. Part of Belleville road, from Michigan avenue to Belleville, will be constructed. All roads but the Eureka road will be 24 feet wide, with 15 feet width of concrete. A few smaller jobs will be done as opportunity offers.



CIVIC BEAUTY

A Practical Civic Organization

The Commerce Club of St. Joseph, Mo., seems to be the first commercial organization to make the civic work of the city the duty of one of its main departments.

Municipal investigation has been done mostly by Bureaus of Municipal Research, such as are found in New York, Philadelphia, Chicago, Dayton, Milwaukee, Westchester County, Toronto, etc. These are backed by private subscriptions, but have no active membership, and in a great degree they lack that which is most essential, i. e., the co-operation and backing of a large club of well-organized citizens. Again, they have often failed financially after a few years, because they had no continuous sustaining body to aid them.

Civic work from a more strictly social viewpoint has usually been handled by charity organizations and societies. While these societies are often strongly organized in smaller cities, their organization from a business and "achieving results" standpoint is not comparable with organized commercial clubs.

The work of the Civic Division of the Commerce Club is a combination of the Bureau of Municipal Research and social agencies. It aims to aid in carrying out the entire community needs of the city and make the city an ideal one from a municipal and civic standpoint. At the same time it helps the city in carrying out its functions with the same economy, forethought and intelligence as shown in our private business.

An industrial commissioner, a traffic commissioner and a civic commissioner working together with ideals and a program will accomplish great things for St. Joseph.

One of its first efforts was a "clean-up week" set for May 11 to 17. A little circular announces the campaign over the signature of W. K. James, the vice president in charge of the civic division of the club, and in a proclamation by Mayor Elliott Marshall suggesting the things to be done and giving the co-operation of city officials and employes.

A full program of work is also given, which covers front and back yard cleaning, tree, hedge, shrub and vine planting, fences, walks, painting, whitewashing, gutters, sodding, screening and covering manure and garbage, filling holes and turning down vessels which might catch rain water, to prevent the growth of mosquitoes, screening doors and windows, providing and applying disinfectants, fly-proofing and disinfecting outhouses and vaults, reporting bad conditions, offering vacant lots for flower or vegetable garden purposes, etc.

This is but the first step taken under the direct supervision of D. O. Decker, the civic commissioner of the club, and others will be announced in the monthly numbers of *The Optimist*, the new publication of the club.

Birmingham the Beautiful

Some sections of Birmingham, Ala., are so well designed and so well improved that no more beautiful streets, lawns and views can be found anywhere. The city has a very large area, nearly 43 square miles, in proportion to its population, about 160,000, and there are many open spaces, some of which are naturally very beautiful and require only a little care to keep them continually in good condition.

The executive department has assumed the promotion of a "city beautiful" movement which has for its object the enlisting of all the citizens in the work of bringing all of the city areas up to the high standard of the handsomest sections. This will be possible with their co-operation in all areas but those covered by the great slag piles of the furnaces, the railroad yards scattered about the city and the like.

But the large corporations have been interested in the movement, have promised their co-operation, and have made contributions to the expenses of the campaign. Steel works and railroads are showing already the results of this co-operation, available spaces being deco-

rated with flowers and grass in increasing amounts, so that in two or three years a very great improvement in these large areas is foreshadowed.

Neighborhoods are encouraged to form city beautiful societies to organize the work in districts and the kinds of detailed work possible to individuals and groups are set out in a booklet giving the outline of the form of such organizations.

A circular makes additional suggestions as to hedges, objectionable and desirable trees, vacant lot cultivation, shrub and rose planting, methods of preventing damage by cattle, horses and chickens, use of the boy scout organization and the benefits of club co-operation by the employment of a worker to do work on streets common to the neighborhood or the purchase of such apparatus as lawn rollers, too expensive for one and useful to many.

The circular offers the services of the city as an employment bureau for men to do the work for those able to pay for it; to haul tree trimmings; to impound animals; to arrest and fine drivers allowing horses to bite trees, and the like; and offers street sweepings free for use as fertilizer. Fire department houses are made distributing points for plants, shrubs, etc., those having them to give away taking them there for distribution to those not able to pay for them. The city office serves as a clearing house for assigning vacant lots offered by their owners to children and others desiring them for cultivation.

A list of annual vines, flowers for various purposes, foliage plants, early and late, which is well classified for the different uses for which they may be desired, is given in the circular.

Another circular gives lists of prizes offered by the Birmingham Horticultural Society, amounting to $225, divided into several groups: e. g., greatest improvement in home grounds, school grounds, church grounds, sidewalk parking strips, rear yards, best porch box on dwelling porch, window box in business building; best appearing vegetable garden on home grounds. But one of the eleven prizes is in cash, the rest being appropriate shrubs, flowers, trees, fruit trees, plants, seeds, bulbs, fertilizer, tree surgery work or spraying, lawn mower, and porch box. The street railway companies have also offered prizes in three contests, amounting to nearly $500 in value, for work along their lines.

The city commissioners specially request every one to plant Enonymus Japonica along the street between the curb and the sidewalk, which remains green thruout the year. The city also offers a reward of $25 for the arrest and conviction of anyone mutilating or removing without permission any of the plants, shrubs or trees on public or private property.

The city commissioners are A. O. Lane, James Weatherly and George B. Ward. The city beautiful work is particularly in the charge of Mayor Ward.

The Postoffice Department, by special arrangement, delivered the printed matter to every inhabited house in the city addressed "To the Yard Beautiful from the City Beautiful," with one cent postage prepaid in cash under the permit system.

Why Not Collect the Tickets?

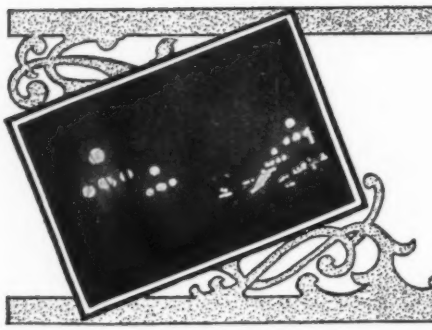
The city of Copenhagen is reported to have installed automatic machines at trolley stations in which passengers can deposit their used railway tickets with a coin valued at a half cent and get a numbered ticket in a monthly drawing of a municipal lottery, in which the prizes are goods of local manufacture. It is said to have operated to reduce the litter from the used tickets dropped in the street.

Park Extension in Waukegan, Ill.

Lake Front Park, in Waukegan, Ill., is being extended east of the city water works plant along the lake shore, the city having begun the surfacing and grading of the area by city teams. Cinders from the pumping plant have been spread to equalize the area and will be followed by a coating of black soil and grass planting. This park extension is made possible by the gradual drifting of sand into the harbor, forming a body of land more than a block long and wide.

Large Philadelphia Park Contract

The great improvements planned for the southern part of Philadelphia include the grading and improvement of League Island Park, work on which has been in progress for eleven years, and no part is yet available for use. Director Cooke has just awarded to Senator Edwin H. Vare, the lowest bidder, the contract for completing the improvement at $523,000. With the completion of Southern Boulevard this year and the letting of the first contracts for grade separations in South Philadelphia, long steps will be taken in the progress of that section of the city.



WATER

Conservation of Purity of Croton Water Supply

The present source of water supply for the City of New York, which will long be one of the sources from which it will draw, is the Croton River, the waters of which are stored in several reservoirs of various sizes, large and small. Its quality and the methods used to conserve it were described in a paper by George W. Fuller before the New York Section of the American Water Works Association, and Dr. Frank E. Hale, in discussion of the same, and these discussions are here abstracted as applicable to many other surface waters stored in reservoirs or lakes.

The Croton water on average is of fair quality. The turbidity is usually moderate, averaging from 3 to 5 in the city; at times of heavy rains in the watershed, particularly when the level of the reservoirs is low, the turbidity may reach as high as 100.

The color is frequently high, running from 10 to 65 on the platinum scale. The watershed contains much swampy land, and the color is of vegetable origin. Odor is perceptible, and is sometimes very marked. Microscopic growths give the water a distinct taste, sometimes very disagreeable. Bacteria are moderate in number, particularly in the city, after the water is treated with hypochlorite of lime. The 1912 records show a range of bacteria at 37 degrees C. of from 5 to 1,200 per cubic centimeter. B. coli, in 1912, are found in 1 cc in 20 per cent. of the tests.

The average alkalinity is 32.

The pollution of the water is of various kinds.

1. The watershed is inhabited by about 25,000 people, whose sewage eventually reaches the reservoirs. Some part of these are provided with sewerage systems; a very small part of the population is provided with sewage disposal works.

To protect the water supply as far as is practicable, the city maintains four hypochlorite application plants in the watershed, located at Mount Kisco, Brewster, Lake Gleneida and Katonah Brook. In addition, all the water passing through the new Croton aqueduct is treated with hypochlorite at Dunwoodie in South Yonkers.

The city also maintains a force of 89 men, whose duty it is to patrol the entire watershed systematically, report on and see to the abatement of all nuisances or sources of infection they may discover, and operate the treatment plants. Of the above force, 28 men are regularly detailed and 61 are used for this service as occasion demands.

2. Microscopic vegetable growths discoloring the water and giving it a disagreeable taste and odor result from the swampy lands forming part of the reservoir system.

To reduce these as far as possible, copper sulphate is applied by the reservoir forces.

3. The watershed contains some 13 miles of railroad track within 300 feet of the flow line, and 18 railroad bridges aggregating 1,700 feet in length. The sewage from the passenger trains enters the reservoirs practically raw, and may often contain pathogenic bacteria. So far, it has not been practicable to enforce proper sanitary control over the wastes from these railroad trains.

The difficulties of asserting authority and abating nuisances are considerable under existing laws, and make watershed protection harder than it should be.

4. Highway bridges, 19 in number, aggregating 4,200 feet in length, discharge their wash into the reservoirs.

5. Wash from roads and run-off from farm lands, and the existence of some 24 miles of swampy land, cause at times a heavy turbidity, and at times a marked color, bad odor and taste.

Typhoid fever has been moderate in New York, particularly of late years. The table gives death rates for New York City and other large American cities for the last thirty years.

The possible danger to the health of the community from infection from the polluted drinking water cannot be evaluated into definite figures. Typhoid statistics

TABLE 6

Annual typhoid fever death rates for various American cities. In deaths per 100,000 population

YEAR	CHICAGO	MILWAUKEE	DETROIT	CLEVELAND	BUFFALO	TORONTO	BOSTON	NEW YORK	MANHATTAN AND THE BRONX	PHILADELPHIA	BALTIMORE	WASHINGTON	CINCINNATI	PITTSBURGH	SAN FRANCISCO	ST. LOUIS	NEW ORLEANS
1880	34	37	.....	44	.....	44	42	25	.....	58	59	54	70	135	34	40	24
1881	105	47	.....	99	67	66	56	38	.....	74	58	86	71	151	37	53	30
1882	82	32	.....	68	69	71	57	32	.....	73	47	66	55	158	61	45	33
1883	62	25	.....	65	34	81	52	32	.....	64	35	62	51	107	64	41	23
1884	56	31	.....	60	42	63	56	29	.....	71	42	76	56	70	58	42	25
1885	75	28	.....	34	23	59	40	27	.....	64	42	65	42	76	44	31	17
1886	69	30	39	56	28	46	34	26	.....	64	39	71	54	68	49	30	13
1887	50	31	65	52	34	61	44	26	.....	63	41	78	142	128	23	28	15
1888	47	42	46	47	29	52	40	23	.....	77	42	87	70	87	33	31	19
1889	48	28	31	74	30	46	43	24	.....	71	47	94	49	95	55	33	17
1890	92	41	19	69	40	93	35	22	.....	64	59	112	69	132	44	31	21
1891	174	33	34	50	51	100	34	23	.....	64	35	82	62	101	42	29	24
1892	124	30	94	59	34	47	29	22	.....	40	44	89	40	100	32	93	20
1893	54	35	42	52	37	45	31	21	.....	41	49	86	44	111	32	44	15
1894	38	25	28	29	59	26	29	17	.....	33	47	91	55	56	37	34	29
1895	38	26	24	35	26	27	33	17	.....	40	36	86	39	78	34	21	44
1896	53	18	23	43	20	27	31	16	.....	34	38	58	52	62	26	20	33
1897	29	12	15	23	20	18	33	16	.....	33	37	48	32	64	19	23	52
1898	41	17	22	34	27	16	34	21	.....	52	36	71	33	73	41	17	66
1899	27	17	13	32	24	20	30	16	.....	75	29	73	37	111	22	23	55
1900	20	17	27	54	26	20	26	21	.....	35	35	78	39	144	13	29	40
1901	29	22	21	36	27	17	25	20	.....	34	27	60	55	125	22	34	48
1902	45	15	24	33	33	13	24	21	.....	44	42	78	62	134	27	37	45
1903	32	17	20	114	35	16	20	17	.....	69	36	48	42	134	.....	47	39
1904	20	14	20	48	23	23	23	17	.....	53	37	47	79	142	27	36	36
1905	17	23	21	15	23	16	20	16	.....	48	36	48	40	99	24	20	32
1906	19	31	24	20	23	26	20	15	.....	72	35	50	70	130	.....	17	30
1907	18	26	35	19	28	22	10	17	.....	59	41	35	45	125	.....	15	55
1908	16	17	22	13	20	20	25	12	11	35	33	37	18	45	.....	14	33
1909	13	23	23	13	23	23	14	12	12	21	25	33	13	23	.....	16	29
1910	14	45	20	19	20	41	12	12	11	17	42	23	6	28	.....	13	32
1911	11	19	17	15	25	20	9	11	10	14	27	21	11	26	.....	11	31
1912	8	25	18	6	11	12	8	10	7	13	24	22	7	13	14	14	14

New York includes Borough of Manhattan only through 1898—since 1898 Greater New York.

are a general indication of the average sanitary quality. A high typhoid death rate shows generally a dangerous water; a low rate, such as ours in New York, shows a water of safe average quality. It does not, however, show that the water may not, at some future time, become grossly polluted by bacteria-causing diseases such as typhoid or other intestinal diseases, in the watershed, and such infection may be transmitted to the city.

For some years the water reaching the city has been treated with hypochlorite, and the grosser sources of pollution in the watershed are individually treated. But, while such treatment we know to be fully effectual and reliable when treating a filtered water or a clear water of small organic content, it is only a rough palliation for waters such as the Croton.

Dr. Frank E. Hale states that the question of filtration has come up and been turned down. Filtration probably will come when the people demand it.

In lieu of filtration, we might run rapidly over the various means which are taken to protect the Croton supply. In the first place, there is continual inspection by the Sanitary Division, under Messrs. Coffin and Culyer. There are regular trips over the various watersheds, streams, reservoirs, etc., to observe physical signs of pollution, and these are abated.

Every case of typhoid fever on the watershed is recorded and carefully looked after. Disinfectants are furnished and, if necessary, the cases are removed to the hospitals. All trains in passing over the watershed have their toilets locked in transit. Bridges over the reservoirs and streams are swept daily to remove the horse droppings, etc.

At several points on the watershed the sewage is treated, and besides, at several small places, chlorination is used. There is a disposal plant at Brewsters, with subsoil irrigation. At Mount Kisco there is an entire sewage disposal plant, comprised of a septic tank, contact beds, sedi-

mentation and filtration beds, followed by chlorination, and the raw sewage goes thru the plant and comes out as clear as crystal and at times safe to drink.

In the Laboratory Division samples are taken weekly from the various sources of supply and analyzed, and also daily from the supply as it leaves Croton Lake, as it arrives at the city at 135th street, and further down in the city, at City Hall. Between Croton Lake and the city, at Dunwoodie, the whole Croton supply is continuously chlorinated.

⚜

¶ TASTE AND ODOR *coming from microscopic organisms is a serious trouble in Croton water which is minimized by proper management of drawing water and treating reservoir.*

Probably the greatest trouble we have with the Croton water is the taste and odor coming from microscopic organisms. We try to avoid this by drawing the water at a depth wherever possible and by treatment locally with copper sulphate. The speaker might say that the reservoirs are so deep that amounts are figured on the top 10 feet only in treating the water. We have also tried the last couple of years to improve the supply by drawing from Croton Lake at depths, in 1912 about 50 feet below the surface, and during the last year about 75 feet below the surface.

During 1912 the thermocline of which Mr. Fuller spoke was some 15 to 20 feet below the surface. During last summer there were two thermoclines, one about 20 to 25 feet and the second at 90 feet. Below 90 feet the water has been completely stagnant, but above 90 feet the draft at a depth has kept the water in circulation.

Here are a few figures to show what the effect of drawing at a depth has upon the supply: In 1911 the temperature during the months of July, August and September at 135th street, that is, of the water as it reached the city, was 72 degrees; in 1912 it was 67 degrees; and in 1913, 65 degrees. The improvement during these three months was 7 per cent. At times the water was at least 10 degrees cooler than in previous years.

The number of microscopic organisms in the water at 135th street in 1911 was 2,836; in 1912, 1,072, and in 1913, 677; in other words, less than 25 per cent of what it was two years previously. That this is due to drawing the water from the bottom is shown from the figures taken at Croton Lake. The surface of Croton Lake in 1913 had 1,405 organisms, against the 677 in the water at 135th street. The samples taken in the screen chamber of the gate house where the water is just starting for the city contained 635, as compared with 677 organisms at 135th street, showing that this benefit did come from drawing the water at a depth.

⚜

¶ CHLORINE TREATMENT *of Croton water removes practically all intestinal germs with ease.*

The treatment of the supply with chlorine at Dunwoodie seems to have been quite effective during the last year. As the water left the gate house at Croton Lake there was an average of 7 per cent. in 0.1 cc., 23 per cent in 1 cc. and 59 per cent. in 10 cc. tests for B. coli. When it reached the city it contained 0 per cent. in .1 cc.; 3 per cent. in 1 cc.; and 23 per cent. in 10 cc. Comparing the tests by multiplying the 0.1 cc. tests by 100, the 1 cc. tests by 10, and adding to the 10 cc. tests, there was 95 per cent. removal of B. coli. In the same way during 1912 there was 90 per cent. removal of B. coli. This reduction was probably caused chiefly by the chlorine treatment.

George A. Johnson, in deploring the abandonment of the project for filtration of the Croton water, made the following statements regarding the limitations of the hypochlorite process:

In making a complete analysis of the practicability of this process, it is necessary to recognize the fact that it is not possible by the use of this germicide to overcome certain disadvantages, such as the following, which do not appear in connection with certain styles of water treatment:

1. Inability to remove or destroy all of the spore-forming barteria not considered to be pathogenic to man, at least, not those common to water.
2. Inability to remove bacteria which are embedded in particles of suspended matter.
3. Inability to remove turbidity.
4. Inability to remove appreciable amounts of color or dissolved vegetable stain.
5. Inability appreciably to remove organic matter.
6. Inability to remove swamp tastes or odors.
7. Inability to remove creosote tastes or odors coming from the cleaning of stills used in the destructive distillation of wood.
8. Inability to soften water; as a matter of fact, the addition of hypochlorite of lime usually results in a slight increase in the hardness of the water, altho this is not ordinarily measurable, notwithstanding the fact that the commercial product usually contains a little free quicklime, which reduces slightly the carbonic acid in the water.

9. Difficulties encountered in applying this process, except with the greatest care, to waters which contain substantial quantities of reducing agents or compounds capable of oxidation, such as nitrites and unoxidized iron.

The foregoing statements set forth the advantages and shortcomings of this process which, like other things that are new, is likely to be, and in some cases is, considered a cure-all for all water ills, no doubt with disappointing results in some cases.

The application of hypochlorite to water, while comparatively simple, should always be carried out with much care and fidelity by a competent analyst; otherwise, if the dose is not adjusted so as to meet satisfactorily all local conditions, there is liable to be alternately an underdose of the chemical insufficient to sterilize, or an overdose which will result in objectionable tastes and odors readily noticeable to the consumers, and due to the bleach itself.

The use of hypochlorites cannot be considered in the light of a substitute for filtration. Where waters are uniformly satisfactory in appearance, but open to suspicion as regards their content in bacteria, the use of the hypochlorite process alone in many cases may prove sufficient. ical appearance and are also polluted and Where waters are unsatisfactory in physrequire filtration, the combined use of filters and the hypochlorite process is called for. As an adjunct to filtration processes it has a distinct field of applicability, as hereinbefore stated, for at a moderate cost it is feasible to obtain a water which is practically above suspicion; and, furthermore, there is brought about a substantial economy in the first cost of the filtration plant. This is made possible by the use of higher rates of filtration than are ordinarily used, and the required filter area may therefore be reduced. It also effects a substantial economy in the cost of operation.

Reservoirs and Their Relation to Epidemics

Altho much of the recent paper by Professor W. P. Mason before the Franklin Institute is occupied very largely in stating the advantages of reservoir storage, it also contains some warnings of the care which must be taken of water in storage to secure the best results. The part of the paper on the necessity of preventing pollution of reservoirs by typhoid bacilli and other dangerous bacteria is abstracted in the following:

Stagnation has its disadvantages, of course. Increase in color naturally follows if water be permitted to remain long in contact with a muddy bottom loaded with soluble extractive matters. Not only is damage to the water's physical appearance a result of such contact, but the material passing into solution is likely to furnish abundant food for those minute forms of life which carry objectionable tastes and smells to many public waters.

The condition of "standing water" of being overstocked with vegetable growths is practically the only one toward which objection can point when considering the pros and cons of reservoir storage.

¶ VEGETABLE GROWTHS IN RESERVOIRS *give much trouble from taste and odor when they decay.*

The word "vegetable" is here to be taken in its broad sense, as it should include not only those growths which would be recognized by the public at large, but also those of the minute world as well, which latter constitute one branch of that lake life known as "plankton."

As an instance of excessive overgrowth, a small lake could be named, which is so loaded with dense vegetation that decay gets ahead of new growth, and the use of its water is productive of temporary diarrhoea. It is a stained water, but its color is not to be considered as a measure of its objectionable qualities for table use, as many water of much darker tint are of excellent quality for such purpose. Color and fitness for drinking bear no relation to each other.

It is true that colorless waters are now demanded by the people and "meadow teas" are growing in disfavor, but that change in public opinion is of recent date and is not based upon established hygienic grounds.

The deepening in color of the lower layers of a water stored upon an unclean bottom; the encouragement of growths of small organisms producing taste and smell by reason of an accumulation of extracted food suitable for their development; and a deficiency in dissolved oxygen in the bottom levels, constitute the sum of objections that can be raised to the impounding of water, and they are much more than balanced by the advantages that accrue from such storage.

The pollution from shore drainage that reaches a reservoir water is likely to be naturally much smaller in quantity than that received by a flowing stream; nevertheless, very serious pollution may occur in a concentrated form, even when the efforts of the caretaker are the most earnest. Thus, the writer has seen numerous loads of stable manure spread upon the very steep banks of a small cup-shaped distributing reservoir. The inten-

tion in this case was good, and much pride was taken in the fine lawns of the water works park, but a better choice of fertilizer could have been made for such a location.

¶ THE WATER SHED *of a public water supply reservoir should be policed carefully and sources of dangerous pollution removed.*

It is entirely possible to protect a reservoir, and, to a great degree, the watershed also, if careful policing of the district be established. Country towns situated upon the banks of streams tributary to the reservoir are the sources of greatest danger, and an earnest effort should be made to remove all privies, manure heaps, farm yards, refuse dumps and other sources of pollution from drainage into the stream or any of its feeders. This is sometimes difficult to accomplish completely, but a high degree of thoroness can be attained by suitable and tactful management.

Board of health rules are expected to cover care of public water sheds, but rules and laws will not enforce themselves, and the city official is commonly at a distance and more interested in the distribution system than in that of collection. The most simple arrangement would seem to be to appoint a local physician in each town or village upon the watershed as the sanitary inspector for that particular district, and to give him authority to employ an intelligent laborer as a sub-inspector, to do the necessary work under his directions.

The writer has found this arrangement both efficient and cheap. In one noteworthy instance, besides caring for the sources of pollution noted above, the sub-inspector's duty included the daily patrol of a mile of railroad track which ran along the border of the reservoir. This question of possible danger from railroad pollution has but recently been recognized. Altho it is always well worthy of consideration, there is no question but that it greatly varies in importance with change in topography, soil or season. Rocky, steep slopes are easily washed by the rain, and frozen embankments naturally fall into the same classification, while flat roadbeds and sandy soils offer better chances for polluting material to be disposed of by natural methods.

Whatever the character of the roadbed, it should be the sub-inspector's care to remove all night-soil dropped from passing trains, and he should exercise greater vigilance in winter than during summer.

The physician-inspector would be in a position to know of cases of disease, such as typhoid, in his district, and, being so informed, could take proper precaution against contamination of the public water, which act on his part would be of vastly more practical value than a location of the trouble by some sanitary commission after an epidemic was well under way.

¶ THE INSPECTOR *of the water shed should be a physician who could find the cases of dangerous intestinal diseases and care for them promptly and effectively.*

The greatest responsibility borne by the inspector, however, would be during periods when gangs of laborers were employed at construction work within the limits of the watershed. Should the workmen be many, and the time of their remaining be two weeks or more, nothing short of incineration of all camp waste and night-soil should be demanded, and the utmost care should be taken that sanitary instructions were carried out to the letter. A Woodruff pit, which can be constructed in a few hours, would be suitable for a temporary camp; while, if something more permanent were demanded, a well-constructed incinerating furnace should be built.

Dr. A. C. Houston, of the London Metropolitan Water Board, has undertaken some very extended researches upon the question of water purification as a result of storage. He found that in stored Thames water the death of typhoid bacteria took place rapidly, altho the rate varied with the temperature of the water. In cold water they lived longer than in warm, and 50 degrees F. seemed to be a critical point, above which their mortality rate was much increased.

In his seventh research report Houston states that typhoid bacilli lived in stored raw Thames water for the following lengths of time:

At start, 103,328 in each case.

Number of Typhoid Bacteria Remaining.

Temp., deg. F.	32	41	50	64
1 week.....	47,766	14,894	69	39
2 weeks....	980	26	14	3
3 weeks....	65	6	3	..
4 weeks....	34	3	..	..
5 weeks....	3	..	..	..

He concludes: "It is difficult to escape the belief that 30 days' storage of river water is tantamount to sterilization, so far as the microbes associated with water-borne epidemic disease are concerned."

Altho Dr. Houston is doubtless sound in his judgment that a great measure of safety will result from four weeks' reservoir storage of a polluted water, yet we must be assured that the period of storage

is real and not simply apparent; or, in other words, we must know that all of the water really does remain in the reservoir for the specified length of time before it is used for public consumption.

If the lake be long, narrow and deep, and all of its water be obliged to traverse its entire length before being taken for supply, then the conditions would appear ideal for purification of the inflowing water before the outlet was reached, and yet even under these excellent conditions it is possible to have introduced unexpected and upsetting factors, as is instanced by the history of the typhoid epidemic at Auburn, N. Y.

¶ LONG - DISTANCE TRANSMISSION *of typhoid fever infection in one water supply is demonstrated and explained.*

Lake Owosso is one of the so-called "finger lakes" of Western New York. Its length is about 10 miles, breadth 1 mile, watershed 190 square miles, depth about 175 feet. A small stream enters its head, and Auburn, a city of some 30,000 inhabitants, has an intake located at the north end, or foot, of the lake and 40 feet below the surface. The temperature of the water at that point in May, 1913, I found to be 42 degrees F.

The peculiar feature of the case which has special interest here is the possibility of polluting material of a fecal character being transported from a village near the head of the lake down the inlet stream and then northward for the entire 10 miles of the lake's length to the Auburn intake, situated near the lake outlet.

We have all faithfully held to the dictum that "sedimentation and time" are the great purifying agencies upon which to rely for the natural improvement of a once polluted water, and it takes a good deal of evidence to persuade us that sewage of a small village could make the trip down such a lake in a length of time and in such a manner as to dangerously affect the water at the lower end. Experimental data, however, have been secured showing that such a result can actually take place. Investigation showed the following facts: The village sewage was, of course, small in volume, but during the winter months it was deposited at several points upon the banks of the inlet stream, and there it collected in a more or less frozen condition until the occurrence of the spring thaw, at which time there was opportunity for much accumulated fecal matter to be washed into the lake in a state of suspension. There was also a chance of its being actually ferried upon cakes of ice, for the reason that certain privies were located upon bridges and fecal matter was dropped upon the very center of the ice-covered stream.

As stated, the shape of the lake is long and narrow and its axis lies north and south. It must be further noted that the prevailing wind is from the south, with a tendency to blow the surface water directly toward the city intake at the north end.

¶ RELATIVE VELOCITIES *of surface and sub-surface currents in the lake were carefully determined.*

By means of triangulation and the use of floats constructed so as to be moved by water currents existing at the different depths of 5 to 20 feet, it was ascertained that the upper strata of water moved southward with the wind, as would have been expected. The rate of this movement being ascertained, it was found that with relatively light winds the movement of the water down to a depth of 5 feet amounted to about 3 per cent. of the wind movement, while at lower depths this water movement diminished to as low as 0.75 of 1 per cent. of the wind movement. Thus, to quote from the figures of Mr. Ackerman, who made these tests, with a wind movement of 6 miles per hour the percentage which the water movement was of the wind movement was as follows: At 5 feet depth, 3.2 per cent.; at 10 feet, 1.74 per cent.; at 15 feet, 0.87 per cent.; at 20 feet, 0.75 per cent.

With a higher wind velocity the water also traveled with a greater velocity, but its movement was then not so large a percentage of the wind movement. Thus with a wind blowing 17 miles an hour the water movement at a depth of 5 feet amounted to but 1.25 per cent. of that of the wind. From these data it was easy to calculate that pollution entering the head of the lake could make the trip to the foot of the lake in three days or less.

Knowing, as we do, from Dr. Houston's experiments, that cold water below 50 degrees F. will favor the longevity of the typhoid fever bacillus, it is easy to see how entirely possible it would be for living germs to reach the intake in dangerous condition.

There is no question but that this particular case, showing, as it does, the dangers that may arise from such winter accumulation, and showing further the possibility, under favorable conditions, of the transportation of such material over considerable distances in a lake, will cause many of us to materially amend our notions about the dependence to be placed upon lake and reservoir storage

as a measure of protection against the evils following water pollution. We should not trust to simple storage without a thoro knowledge of just how it is being accomplished. The writer has in mind an instance of a large lake, some five miles in length, which has a stream entering within one mile of a city intake, and, because of the entering water having a low specific gravity, there is a possibility of it flowing over the surface of the lake toward the intake whenever the wind is in the right direction. The great length of that lake is, under the circumstances, of small value for purification purposes.

All of this certainly goes to show that we should be cautious about banking too strongly upon the efficiency of reservoir purification under all circumstances, and it demonstrates the necessity of our being well acquainted with the conditions surrounding each individual case before venturing an opinion on the matter.

It should be noted here that, in judging of the bacterial efficiency of lake or reservoir storage, the interpretation of the results of an examination may be obscured by an increase in the total count of bacteria reported due to the disturbing influence of the spring or autumn "turnover."

In conclusion, permit a word to be added concerning the value of storage as a protection against spreading disease thru the use of an "emergency" water supply. The underwriters very properly insist upon a sufficient fire service, which shall be available in the event of a temporary breakdown of the regular distribution system. It too often happens that upon such occasions a very inferior water is supplied by the "emergency intake," and as a result of its use there follows an outbreak of typhoid fever. Commonly, some old intake is allowed to remain in place for "emergency service," when pollution of the former supply has so grown in intensity as to force the authorities to seek a new source for public water.

Further fouling of this old supply goes on progressively as population increases, until after some years the water becomes practically dilute sewage. Suddenly some accident to the regular water system induces the authorities to open the old gates, and the result may be imagined.

Such has been the history of typhoid epidemics in a number of cities.

Storage for a sufficient length of time, supplemented, if necessary, by an appropriate dose of bleaching powder, will render even a poor water acceptable for emergency uses, and the reservoir capacity for such storage need not be large.

Municipal Water Supply for San Francisco

The Board of Supervisors of San Francisco has authorized test wells in certain districts not now supplied or poorly supplied with water, and will put in pumping plants if water is found to serve until the Hetch Hetchy system is completed.

The Spring Valley Company will extend pipe lines and furnish water to the extent of its capacity until the transfer is made, but cannot supply the demands in all the new districts.

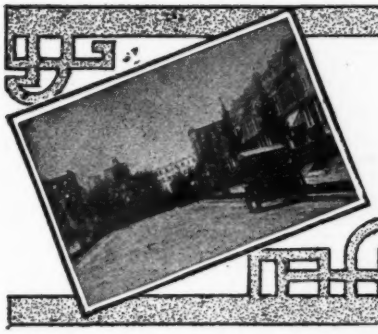
American Motor Apparatus Used by Vancouver Fire Department

The report of the chief of the Vancouver, B. C., fire department shows that its equipment consists of eighteen pieces of automobile apparatus—two ladder trucks, eight hose wagons, one combination hose and chemical wagon, five chemical engines, one chief's car, and one assistant chief's car; one self-propelled steam fire engine, fourteen horse-drawn apparatus—four steam engines, two ladder trucks, five hose wagons, one combination hose and chemical wagon, and two chemical engines; and thirty-one horses.

Owing to the city's recent rapid growth, it has been enabled in purchasing to secure apparatus of the latest improved makes, and in consequence has an excellent equipment for a city of its size and population. The first automobile apparatus was purchased in 1908, and since that time whenever old apparatus was replaced or the demands of the city required increased equipment, this class of apparatus has been added. All automobile fire apparatus is of American manufacture.

Financing Amsterdam, Holland

It will require about $15,650,000 to operate the City of Amsterdam, Holland, for 1914, an increase of nearly $800,000 over 1913. As the city owns its gas, water, electric light and power, street railway and telephone systems, many of the docks and a large amount of ground in the business portion of the city, leased for building purposes, more than half this sum is raised from the proceeds of their operation, nearly two-fifths being from ground rents, and over one-fifth from the municipal public service plants. Taxes supply about one-third of the necessary funds.



ROADS AND PAVEMENTS

Progress of the Asphalt Industry

The annual reports of the General Asphalt Company to its stockholders are good indexes of the progress made in the asphalt industry, for that company practically controls three of the most prominent and valuable sources of asphalt, and has recently made some development of asphalt oils derived from wells in the same regions as the Trinidad and Bermudez asphalt lakes.

The business of the company is reported to have shown a heavily increased demand for asphalt and asphalt products during the first eight or nine months of the year, for road and street construction purposes, but the last months in the year showed a marked falling off, due to the difficulty in marketing their securities experienced by contractors as well as municipalities. The improvement in the market for such securities this spring promises good business for the year 1914.

The tariff of $3 a ton on refined asphalt and $1.50 a barrel on crude was removed by the tariff act of 1913, which will somewhat reduce prices for Trinidad and Bermudez asphalts hereafter.

The entire tonnage of asphalt sold and consumed by the company in 1913, reduced to a basis of crude asphalt and including Trinidad and Bermudez asphaltic products of all kinds, Trinidad liquid asphalt and its products, amounted to 312,222 tons, an increase of 7 per cent. over the preceding year and of 66 per cent. over 1909.

The use of asphalt for road work has increased very rapidly in recent years. In 1913 33,020 tons of Bermudez road asphalt were sold for such purposes, enough for 4,308,000 square yards of road surface, or 490 miles of roadway 15 feet wide. This is an increase of nearly 1,800 tons over 1913 and from only 1,500 tons sold in 1909.

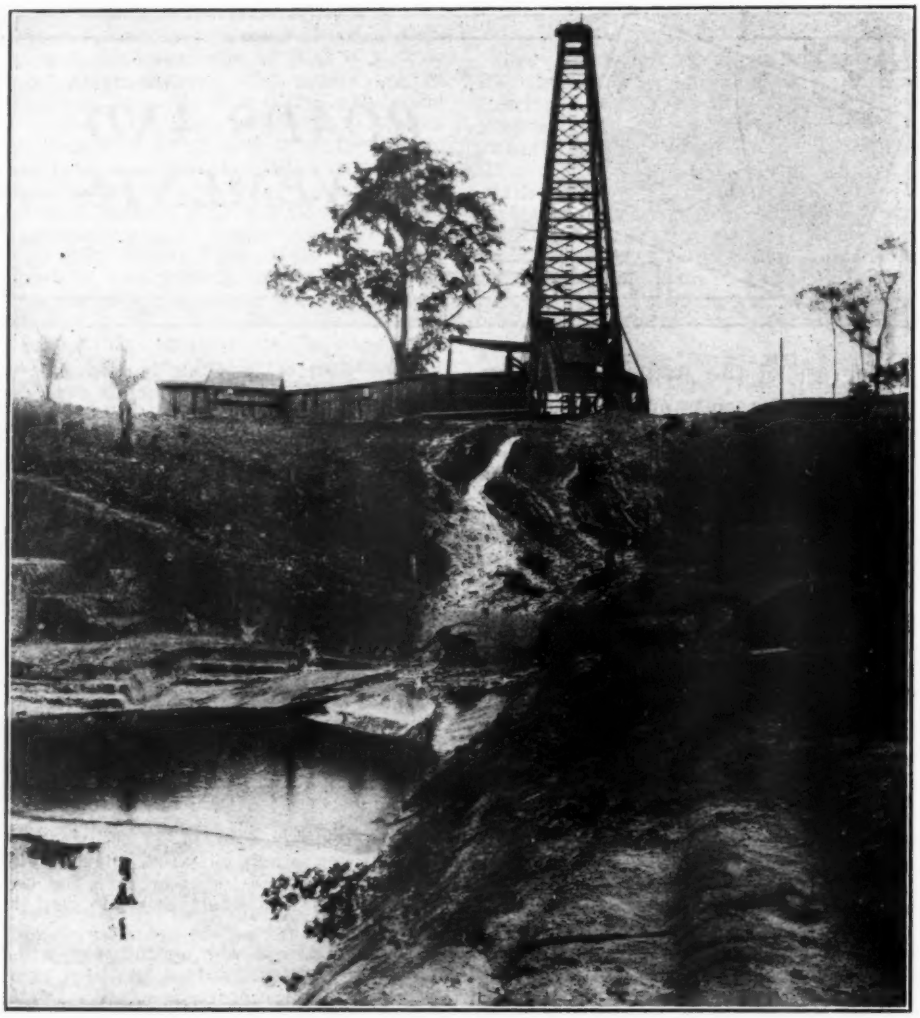
Trinidad liquid asphalt has been on the market three years, and 3,601,322 gallons were sold last year, a little more than one-third the total amount sold.

Only 19,457 tons of gilsonite were shipped out over the company's railway to the district in Utah in which it is found, a falling off of some 40 per cent. from the shipments in 1912.

The Barber Asphalt Paving Company is the construction arm of the organization, and it seems to have been the policy in recent years to use the working capital of the parent company in the handling of asphalt more largely than in building pavements. As a consequence, the yardage of sheet asphalt constructed by the company in 1913 was 947,469 square yards, less than half the work done in 1911. The pavements built with other materials by the company in 1913 covered 533,032 square yards, only 55 per cent. of the work done in 1911. These figures do not include 586,413 square yards of pavement laid for private parties and repairs for which payment was received.

The company sold $1,471,247 worth of asphalt for other purposes than paving in 1913, a slight increase over the preceding year and nearly 50 per cent increase over 1909.

The length of the period for which pavements are guaranteed has been greatly reduced during recent years. Of the 1,480,501 square yards of pavement of all kinds constructed in 1913, 51.6 per cent. were without guarantee. Since 1905 the percentage of pavements laid without guarantee has increased from 6.4 to 51.6 per cent. The average length of guarantees on pavements laid has reduced in the same time from 7.2 years for those laid in 1905 to 2.45 years for those laid in 1913. There has been a consistent reduction in this figure each year except 1908, when there was an apparent increase of 0.2 year over the 5.0-year average of 1907. Nearly all the pavements guaranteed in 1913 were for the five-year period, 725,229 square yards, there being only 674 yards guaranteed for one year and 398 for three years. The yardage of pavements guaranteed is more than 200,000 less than the yardage of sheet asphalt pavements constructed, so that the omission of guarantees takes place with respect to sheet asphalt as well as



ONE OF THE OIL WELLS *of the General Asphalt Company on the Island of Trinidad, from the product of which Trinidad liquid asphalt is derived.*

with respect to other and newer forms of asphaltic pavements and roadways.

Of the guarantees expiring in 1913 on 3,124,773 square yards of pavement, over half, or 1,644,324 square yards, were for ten years, 764,764 for five years, 363,557 for fifteen years, and 206,982 for two years and the others in smaller amounts for one, three, seven, eight and nine years. The average length of the expiring guarantees on these pavements was 8.54 years.

The yardage of pavements still under guarantee has been reduced to 11,868,364, from nearly double that figure in 1907. Over half of this is for five years or less, and only 217,986 square yards for over ten years. There remain less than 150,000 square yards in all which are under fifteen-year guarantee, and but little over 5,000,000 yards under ten-year guarantee.

The most interesting part of the report is that covering operations for obtaining petroleum in Trinidad and Venezuela. The wells have been very difficult to complete on account of the large quantity of oil, the enormous gas pressure and the great thickness of the series of formations in which the oil is found. Notwithstanding these difficulties and consequent delay in finishing wells, the burning of the best well and a small outbreak of yellow fever which stopped all opera-

tions until it was stamped out, the crude oil produced in the year was 362,684 barrels, as compared with 247,208 barrels in 1912. Since operations were resumed in February the yield has averaged 1,000 barrels a day.

These oil wells are located in several groups near the famous Trinidad asphalt lake and are connected by pipe lines with the shipping stations to which the oil is in part pumped and in part runs by gravity.

In Venezuela nearly all the wells are in or on the borders of the Bermudez asphalt lake. The oil here found is very heavy, too heavy to pump, but it is under very heavy gas pressure, which causes it to flow out of the few wells which have been drilled. The heaviness of the oil and the enormous gas pressure make these wells hard to drill and to control. One well produces 1,000 barrels a day and another 600, tho neither of them has yet passed thru the whole of the series of oil-bearing formations.

The Yellow Pine Ring Rule

At a meeting of the Yellow Pine Manufacturers' Association in Chicago on May 5 the committee on grades made a favorable report on a proposed change in, or addition to, the grading rules relating to pine timbers, and the meeting accepted the committee's report. That action, however, did not constitute an adoption of the proposed change, but will serve to bring it before a future meeting of the association, which will have authority to adopt, modify, or reject.

The ring rule is not a new thing as applied to pine timbers. Its principle is well understood. It is based on the number of rings of yearly growth per inch on a line measured from the tree's heart to the bark. The recent purchase by the Panama Canal Commission of six million feet of southern yellow pine on an inspection based largely on the number of rings to the inch has brought the matter to the front at this time. There are four leading southern yellow pines, commonly called long leaf, short leaf, loblolly and Cuban. The first of these is usually of slow growth, with narrow rings. It is known commercially as hard or Georgia pine, and possesses great strength when the timber is of slow growth. The other three pines usually grow more rapidly, with wider rings; but any of the pines may grow slowly or rapidly, depending upon whether conditions are favorable or unfavorable.

The proposed ring rule does not favor or disparage any particular species of southern yellow pine, but is concerned only with the width of the growth rings. This is on the assumption that timbers with rings of the same kind are of the same strength, without regard to exact species. In connection with the number of rings to the inch, their character is likewise considered, with regard to the proportion of the ring composed of dense summer wood and of lighter spring wood.

The proposed rule has been favored because of its simplicity, and especially because it would remove a fruitful source of disputes and misunderstandings concerning the exact species of yellow pine. Anybody can count rings and measure with a rule, but it is not always an easy matter to determine the precise species of pine from which a timber was cut.

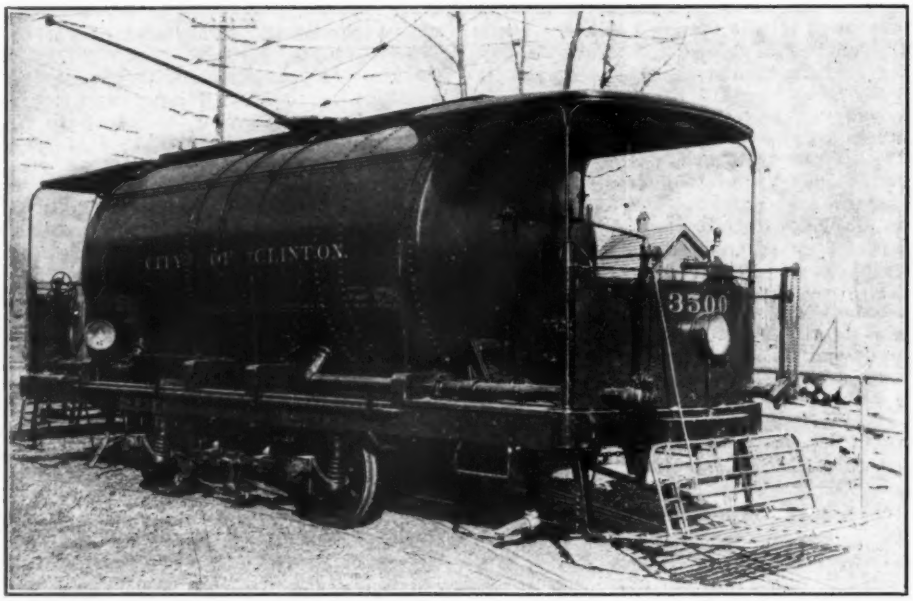
The Forest Products Laboratory at Madison, Wis., paved the way for the adoption of such a rule by making numerous tests of pine beams to ascertain their strength in relation to the width of the rings and the comparative quantities of spring wood and summer wood. The tendency of the tests all pointed one way, and showed that, so far as the southern yellow pines are concerned, strength is not a matter of species but of structure, and that two trees with similar rings do not differ much in strength, tho one may be long leaf and the other loblolly.

On a ring rule system of grading, timbers would be classed as "dense wood" and "not dense wood." A somewhat explicit definition of what dense wood is would necessarily form an important paragraph in the grading rules. The definition which the committee had before it at the meeting on May 5 was as follows:

Dense wood shows on cross section an average of not less than eight growth rings per inch, measured over the third, fourth and fifth inches, on a radial line from pith to circumference, containing in the greater number of rings one-quarter or more of summerwood; or it may have an average of six or seven rings as above, provided that, in the greater number of rings, one-third or more of the ring is summerwood; or wider ring material if in the greater number of rings, one-half or more of the ring is summerwood as above; and the ring must show a sharp contrast in color between springwood and summerwood.—*The Hardwood Record.*

Sprinkling Street Car Tracks in Clinton, Iowa

A little over a year ago the Clinton, Iowa, Street Railway Company received a new franchise to operate in Clinton for the next 25 years. A clause in their franchise provides that they shall operate a sprinkler car. The city had no money to use for the purpose of purchasing this car, so, in order that the citizens



CAR FOR SPRINKLING *the streets of Clinton, Iowa, purchased by popular subscription and operated by Street Railway Company under its franchise.*

might have this service, the Commercial Club raised by popular subscription along the lines of the street railway company an amount sufficient to purchase a sprinkler car, $3,500. The car cost complete on track ready for service $3,744.81. The capacity of this car is 3,000 gallons. It is equipped with four sprinkler heads and two flusher heads. It requires two men to operate the car.

The accompanying photograph shows the car ready for operation.

Modern Bituminous Surfaces and Bituminous Pavements

By Arthur H. Blanchard, M. Can. Soc. C. E., Professor of Highway Engineering in Columbia University, New York City, before the Canadian Good Roads Congress, May 20, 1914.

The various methods of using bituminous materials will be explained by the following definitions:

Bituminous surfaces are those consisting of superficial coats of bituminous materials with or without the addition of stone or slag chips, gravel, sand or materials of a similar character.

Bituminous macadam pavements are those consisting of broken stone and bitutails of the original construction. It has been found that a road with a thoroly rolled and well-puddled broken stone wearing surface composed of road metal from 1 inch to 2½ inches in longest dimensions may be easily cleaned and the minous materials incorporated together by penetration methods.

Bituminous gravel pavements are those consisting of gravel and bituminous materials incorporated together by penetration methods.

Bituminous concrete pavements are those having a wearing surface composed of stone, gravel, sand, etc., or combinations thereof, and bituminous materials incorporated together by mixing methods.

Bituminous Surfaces.—In the case of broken stone and gravel roads, the most efficient method of procedure is to thoroly clean the surface by sweeping with hand brooms or horse sweepers and hand brooms, the final sweeping being done with bass or other fine fiber brooms. The bituminous material, which is generally heated, is applied to the surface in amounts varying from one-quarter to one-half gallon per square yard, with the aid of pouring cans, hose attached to tanks, hand-drawn gravity distributers, horse-drawn or motor-truck gravity or pressure distributers. Some kind of mineral coating is generally applied to cover the bituminous material. The degree of cleanliness of the surface obtained by sweeping will depend to a large extent upon the de-essential adhesion of the bituminous surface readily secured. This method is characteristic of the modern practice of

many of the foremost English and French engineers.

Considerable development has taken place in the use of different kinds of bituminous materials. Tars, both of the water gas and coal gas types, continue to be used to a large extent. There has been noted a growing objection to the use of certain asphaltic oils which require from two to three weeks to "set up" to such an extent that tracking will not occur.

Bituminous Macadam and Bituminous Gravel Pavements.—Bituminous macadam and bituminous gravel pavements are of many types, one of the primary differences in construction being the use of one or two applications of the bituminous material. The efficacy of many of the types depends upon the combinations of sizes of broken stone or gravel and the combinations of bituminous materials used when two applications are employed. Variations in types also exist, dependent upon the manner in which the different courses may be filled and the treatment of the filled course prior to the application of the bituminous material. The one-application method is very similar in its simplest form to the construction of a bituminous surface, except that the bituminous material is applied upon a much more open surface. In the case of the two-application method in certain instances an attempt is made to build up a two-course pavement, while in others the second application is in reality used as a seal coat.

Two methods of construction which have given satisfactory results will be cited as examples of modern practice.

When the metaling in the wearing course consists of a naturally graded aggregate ranging in sizes from one-half inch to an inch and one-quarter, it has been found unnecessary to further fill the voids by the application of a finer product before the first application of the bituminous material. The character of the product referred to above is shown by the following mechanical analysis:

Percentage passing ½-in. screen....	18.9
Percentage passing ¾-in. screen....	43.1
Percentage passing 1-in. screen.....	34.4
Percentage passing 1¼-in. screen...	3.6
	100.0

After the wearing course has been thoroly rolled, from one and one-quarter to one and three-quarter gallons to the square yard of bituminous material is uniformly distributed. Stone chips, free from dust, are then distributed to fill the surface voids. After the chips are rolled a seal coat of one-half to one gallon per square yard of bituminous material is applied. The pavement is finished by the rolling of a second application of stone chips.

As the second method will be described what the speaker considers the most satisfactory type of bituminous macadam pavement at present constructed in England. The bituminous pavement referred to is known by the name of "Pitchmac," and was designed by the city engineer of Liverpool, John A. Brodie, M. Inst. C. E. The following description of the standard method employed in Liverpool is given by Mr. Brodie:

"Pitch-grouted macadam has been found to give most satisfactory results in streets of medium and light traffic, and is now being largely used in place of ordinary macadam, and also of more expensive pavements. It is laid to a depth of from 3½ inches to 4½ inches, in two layers. Welsh granite macadam is used, broken to a 2½-inch gage for the lower layer and to 1½-inch for the top surface. Each layer is put down dry and continually rolled before and after the grouting of pitch and sand mixture has been applied, until the surface is thoroly consolidated. The foundation is generally of hand-pitched rock, 10 inches deep, as for ordinary macadam, but in some cases a bed of 6-inch concrete has been used on main roads. Pitch macadam is also being much used as a surface covering for old boulder pavements, many of which still exist in Liverpool in old streets where the traffic is very small. The cost of pitch macadam may be taken at 1s. (24 cents) per square yard per inch of depth."

Bituminous Concrete Pavements.—The simplest type is one having a mineral aggregate composed of one product of a crusher, that is similar to the product in the usual type of portable crushing and screening plant, which passes over one screen and thru the larger holes of the adjacent screen. This broken stone, in certain cases, may be somewhat uniform in size, but usually such is not the case. In the speaker's opinion, an essential element in the construction of this type of bituminous concrete pavement consists in using a product of a crusher which will have a range from an inch to an inch and a quarter in its sizes. As an illustration will be cited a mechanical analysis of a product which was obtained from a plant where the broken stone passed over a ½-inch screen and thru a 1¼-inch screen.

Percentage passing ⅛-in. screen....	1.2
Percentage passing ¼-in. screen....	4.2
Percentage passing ½-in. screen....	34.7
Percentage passing ¾-in. screen....	40.6
Percentage passing 1-in. screen.....	17.3
Percentage passing 1¼-in. screen...	2.0
	100.0

It is apparent that the above product

would not be referred to as composed of uniform sized stone. It is of interest to note that certain bituminous concrete pavements, having a width of 25 feet, constructed with this product of broken stone in 1911, have been subjected to an average daily mixed traffic of 2,000 to 3,000 vehicles, and are at present in excellent condition, with no maintenance charges to date.

This type of bituminous concrete pavement has been constructed for many years by using either one, or, in certain cases, several courses of broken stone mixed with bituminous cement. As an illustration of the latter method will be cited the practice of one large construction company which builds this type of pavement. The first, or bottom, course, of metal coated with bituminous cement, ranges from 1¼ inches to 2½ inches; the second course, from ½ inch to 1¼ inches, and the third course, from ¼ inch to ½ inch. The pavement is finished with a dressing of uncoated chips.

Asphalts, tars and tar-asphalt compounds have been used for the bituminous cement. In some cases one kind of bituminous material has been used in the mix and another kind for the seal coat, one of the most common combinations being the use of tar in the mix and asphalt for the seal coat.

The second type usually consists of the broken stone composing one product of a crusher and sand or other fine mineral matter mixed together with a bituminous cement. The wearing surface of this mix is sometimes finished by rolling in fine stone chips, but generally a seal coat is used, together with fine mineral matter, for a top dressing. When constructed on a commercial scale, the mineral aggregate is always heated and mixed in a specially constructed machine. Usually the same grade and type of bituminous material is used for the mix and the seal coat.

In the third type of bituminous concrete pavement the composition of the mineral aggregate is definitely covered in properly drawn specifications. As an example may be cited the following method of covering the composition of the mineral aggregate of Warrenite, a proprietary pavement of the Warren Brothers Company, which was used by William H. Connell, chief of the Bureau of Highways, in drafting specifications for the city of Philadelphia:

"Material passing 1¼-inch screen and retained on No. 2 sieve, 40 to 60 per cent.; material passing No. 2 sieve and retained on No. 4 sieve, 10 to 20 per cent.; material passing No. 4 sieve and retained on No. 10 sieve, 10 to 5 per cent.; material passing No. 10 sieve and retained on No. 30 sieve, 10 to 5 per cent.; material passing No. 80 sieve, at least 25 per cent. of which will pass a No. 200 sieve, 10 to 5 per cent. The balance to pass No. 30 sieve and be retained on No. 80 sieve."

The 1914 specifications of the state of New Jersey contain the following description of the grading of a bituminous concrete pavement similar to the one given above:

Passing 1½-in. and retained on 1-in. mesh	0	to 15	%
Passing 1-in. and retained on ½-in. mesh	40	to 50	%
Passing ½-in. and retained on ¼-in. mesh	10	to 25	%
Passing ¼-in. and retained on a 10-mesh sieve	8	to 15	%
Passing 10 and retained on a 30-mesh sieve	12	to 22	%
Passing 30 and retained on an 80-mesh sieve	5	to 15	%
Passing 80 and retained on a 200-mesh sieve	3	to 8	%
Passing a 200-mesh sieve	2	to 8	%
Bitumen content	6.5	to 8.5	%

As another illustration might be cited the well-known Topeka specification, which covers a definite grading of a mixture of broken stone and sand. The Topeka grading is as follows:

Percentage of bitumen, from	7 to 11
Percentage of mineral aggregate passing 200-mesh screen, from	5 to 11
Percentage of mineral aggregate passing 40-mesh screen, from	18 to 30
Percentage of mineral aggregate passing 10-mesh screen, from	25 to 55
Percentage of mineral aggregate passing 4-mesh screen, from	8 to 22
Percentage of mineral aggregate passing 2-mesh screen, less than	10

In the construction of all types of bituminous concrete pavements, in addition to the requirements covering the properties of the bituminous cement and the quality and character of the mineral aggregate, certain essential features should be given careful consideration. The following citations from the 1914 Report of the Special Committee of the American Society of Civil Engineers are especially pertinent:

"Where the character of the traffic justifies the use of a bituminous concrete pavement, the same conditions demand an extraordinarily strong foundation therefor.

"The amount of bituminous material to be used in any case will depend upon the peculiar conditions of that case, such as the kind of road metal and of bituminous material, the character of the aggregate, the climatic conditions, etc.

"The character of the mineral aggregate to be used may be controlled by local conditions, but the best results can only be obtained by the use of the best ma-

terials. Excessive sizes, or excessive variations in the size of the mineral particles, should be avoided, and the utmost care must be taken to avoid the segregation of the different sized particles.

"Mixing machines should be used, and hand-mixing methods should be avoided wherever practicable.

"In the use of a heated aggregate for the construction of a bituminous concrete pavement non-uniformity or excess in the heating of stone should be avoided.

"Where bituminous pavements are laid, the edges should be protected and a sudden transition from the pavement to any softer shoulder material avoided by means of cement concrete or other edgings and such reinforcement of the shoulder material as may be necessary."

Good Roads a Factor in Real Estate Values

According to the *Newark News*, the construction of improved roads and the possibility of other new highways connecting all the important towns of Sussex county, N. J., figure in increase of real estate values at many points in the county. It has a great deal to do with keeping the real estate market going. Some deals result purely from a desire of the purchaser to deal in "futures." The new owners are improving the properties in a number of cases.

Concrete Paving for Buhl, Minn.

After watching a moving picture exhibit of methods of building concrete roads, a meeting of the citizens of Buhl, Minn., decided almost unanimously in favor of concrete roads. The Council used this means of learning the public sentiment, and will do a large amount of work this year. The bill for the portion of the paving between the tracks will be paid by the interurban electric railway running thru the city.

Subway for Buenos Aires

The city of Buenos Aires, Argentine Republic, recently opened the first two-mile section of a subway system which, when completed, will extend eight miles and connect all parts of the city. The running time between the two important plazas connected by the subway has been cut in two and is now 15 minutes. A unique feature is distinguishing stations by finishing each one in different colored tiles, one sky blue, one yellow, one green, etc., there being a station about every three blocks. Transfer tickets between surface lines and subway cost 2 cents.

The City Manager

The Engineer's Club of Cincinnati was addressed May 21 by Henry M. Waite, city manager of Dayton, and formerly city engineer of Cincinnati, on "The City Manager Form of Municipal Government." Mr. Waite said in substance:

"The city governed by a commission and city manager is analogous to any of our large corporations. The people are the stockholders. The commissioners are the directors and the city manager is their representative selected to conduct the business in the most efficient manner possible.

"Since both the commission and the city manager are subject to recall after six months in office, the people have every means to enforce their wishes fully.

"No serious drawbacks in the Dayton charter have yet developed.

"Elimination of politics from municipal affairs eliminates the need for civil service.

"When appointments are made on a strictly merit basis, greater efficiency may be obtained without civil service than with it. Civil service is necessary in the federal form of municipal government in order to eliminate partisan appointments.

"With the advent of the commission-city manager form of municipal government, there has been opened up a new field for the engineer. His is an ideal training for solving most municipal problems. He is a trained economist and efficiency expert. Inquiries come daily to the Dayton commission and city manager from universities, colleges and technical schools, asking for information upon which to base plans for new courses in city management and municipal engineering.

"Cincinnati with its municipal university and its co-operative courses has an ideal opportunity to offer courses for the study of municipal management to its students."

Municipal Lighting Plant for South Hadley, Mass.

A special committee of five, appointed at a special town meeting of the citizens of South Hadley, Mass., to investigate the matter of municipal lighting for the town recently made a report unanimously in favor of the establishment of a municipal lighting plant. Their engineer, William Plattner, of North Attleboro, goes into details concerning all parts of the problem and bases his report of cost on the purchase of the existing private plant and of his recommended improvements, making a total, with salvage, of $27,000. The town has about 250 street lights.

MISCELLANEOUS

British Municipal Ownership

Albert Halstead, United States consul at Birmingham, England, has made a careful and non-partisan report on the operation of public service industries by municipalities in England, which shows the general features and results apparently in a very fair way, which is confined to statements of fact and not of opinion.

There are many more cities in the United Kingdom supplying gas, electricity and street railway service than in the United States, and a fully equal number supply water, public markets, sewerage, etc. Many British cities also build and rent workmen's dwellings, a development which has not yet been started in this country.

Mr. Halstead states briefly the general objections to and points in favor of municipal ownership of public service utilities and the influence of the differences in the conditions in England and America upon success or failure in the one as compared with the other. He states that in some cases municipal undertakings have been managed most unsuccessfully and shown a great loss. Reference is made to undertakings from which a profit should be made under careful management. In these cases there has been slackness in management, waste, or unbusinesslike practices. Such instances have been characteristic only of small undertakings and in localities where it was difficult to get capable experts to conduct them, or where the managing committees seem to have been inefficient. There are also a few and isolated instances in which municipalities, after undertaking to perform such services, have sold their plants to private companies. Real failures are, however, strikingly fewer than the successes, and cases of resale to private companies do not equal those where undertakings have been recently purchased by local authorities.

An examination of the table of deficiencies on trading undertakings shows that the losses on same are very largely confined to the provision of water. In the United States the provision of water might not generally be regarded as a public service on which profit was ordinarily to be expected, but would probably be considered as one that should be classed with ordinary sanitary services, such as sweeping of the streets, removal of refuse, the construction of sewers, etc., for which it is proper, if necessary, to tax the community.

However, the provision of water by American municipalities is not generally a heavy charge, and at times affords a slight profit, and that, too, when the ordinary cost of the water supply to the communities in the United States is much less than the charge made in the United Kingdom. Therefore, where the provision of water causes a charge upon the taxpayers in England to subtract this deficit from the profits of other undertakings might not be regarded as fairly indicating the profitable results of municipal trading. In the case of the City of Birmingham, the cost of the water supply over the revenue obtained for it is exceedingly high, aggregating £74,968 ($364,822) for the last municipal year. That charge, however, is due to the fact that Birmingham, in order to obtain a supply of water to meet present and prospective requirements, was compelled to go eighty miles into Wales, purchase a large area of ground, build very costly aqueducts, receiving reservoirs, etc. When Birmingham was considering making an additional water supply, estimates of the cost were obtained. Unfortunately, the estimates were too small, largely because of the character of country from and thru which the water had to be conveyed, and of the earth structures where dams had to be built. Consequently, the cost of the supply was very heavy. Loans for most of the works had to be for a period of sixty years from the date of borrowing. This makes provision for sinking fund and interest yearly very large, and a heavy charge on the undertaking. Tho water rates are high from the American standpoint, the revenue does not meet unavoidable charges, and hence the large

deficit. A further pipe from Wales being required, the cost of the rates of Birmingham water supply promises to be still greater. The water, however, is of most excellent quality.

Workmen's dwellings do not constitute a charge on the rates in Birmingham, or, as a rule, it is said, in other cities. Nevertheless, this is partially a sanitary provision. In the late seventies the City of Birmingham purchased a slum area and constructed a business street through the same, retaining the freehold of the same. For this purpose money was borrowed. The loans have not become due, so the interest charged on the same and the necessity for providing for the redemption of the loan when due constitute a charge on the revenues of the city. However, the construction of this business street, which is now one of the most important in the city, created a ratable or taxable value from which is obtained more than enough in rates and taxable value to pay the interest and sinking fund charges. In the accounts this does not show, so the scheme is made to appear a loss. When the leases fall in, the buildings erected under those leases will become the property of the city, and a very valuable asset, the revenues from which will equal at least £100,000 ($486,650) a year. In these circumstances it is not wholly just to charge the interest and loan redemption expenses of this striking city undertaking—one of the finest examples of town planning—against profits from the gas, electricity, street railway and markets undertakings.

It has been indicated that water rates are higher in England than the United States. On the contrary, those for gas are generally much lower. For short distances in England street car fares, which are based on the distance traveled, are much cheaper; but for long distances considerably higher. Municipal gas and electricity departments show much enterprise. Street car services are good, but, on the whole, the cars are not as good and the services sometimes not up to the American standard.

In the tables accompanying the report are statements of the losses or gains in each municipality from the municipal operation of markets ,gas, water, electric light, tramways, estates owned including municipal housing, and other methods of municipal trading. Of 116 cities included in the column of totals 91 showed profits running from $1,012 in one small town to over $900,000 each in Liverpool and Manchester. If the losses on water supply are not included, five or six cities would move over to the list of those showing profits and some twenty would have their showing of profits increased. The tendency to handle water works as a sanitary measure, with only secondary attention to profits, is shown by the fact that of the 61 water works in the list 25, or over 40 per cent, showed deficits in their operations.

The percentage of unprofitable plants runs about 4 in markets, 10 in electric light plants, 23 in street railways, 8 in housing schemes and less than 2 in gas plants. These figures are interesting from another point of view. Water rates are higher in England than in the United States, but the unprofitable water plants are numerous in England. Gas rates are much lower in Engalnd than in the United States, and there is but one unprofitable plant in the 51 municipal plants listed. Gas rates run from 26 cents per 1,000 cubic feet for domestic lighting in Widnes, population 32,256, profits $1,698 in the year, to 87 cents in Lowestoft, population 34,729, operated by a private company. The highest price reported from a municipal gas plant is 83 cents a thousand cubic feet for domestic lighting supply in Kings Lynn, population 20,200, the financial results of which plant are not reported.

The report in full is published as House Document 710, 63d Congress, 2d Session.

Regulation of Capital and Rates of Public Service Corporation

A report on the regulation of public service companies in Great Britain, with supplementary chapters on the Boston sliding scale and Toronto auction sale and maximum dividend plans, by Robert H. Whitten, Librarian-Statistician, New York Public Service Commission for the First District, New York, is reprinted from annual report of the Public Service Commission for the First District of New York and distributed separately.

This report is the result of some six months' special investigation and study undertaken by Dr. Whitten in behalf of the Department on Regulation of Municipal Utilities of the National Civic Federation. The material having served the purposes of the Federation is now published by the New York Public Service Commission in the hope that it may prove suggestive in the study of a number of the problems in public service regulation.

In this report Dr. Whitten has treated phases of the regulation of public service companies in Great Britain that are of peculiar interest in connection with our own problems. He has selected for special study those phases of control that seem to offer most in the way of suggestion in the solution of American problems. His report is not, however, a mere statement of British institutions but in the case of such important questions as the sliding scale of rates and dividends, the sale of premium shares at auction or

by public tender, and the audit of company accounts, it presents a careful and discriminating discussion of the general principles underlying these methods of control and of their applicability to American conditions.

The British sliding scale system for the automatic regulation of the rates of charge and dividends of gas companies is coming to be looked to by many as a remedy for the uncertainties and possible evil effects of our present system of occasional rate regulation. Dr. Whitten's analysis of this important subject is the most complete that has yet appeared. He has made a particularly searching inquiry into the proper basis for the apportionment of the savings or profits between the shareholder and the consumer. Dr. Whitten recommends certain changes in the sliding scale system as applied in England and Boston but on the whole considers that it has important advantages over the American system of occasional rate regulation. He, however, develops a new system of control which he calls "the merit rating method," and which he recommends as superior to either of the above. Under the merit rating method the state commission "will periodically rate the companies on the basis of comparative efficiency in serving the public and allow them to earn dividends varying with such efficiency." This is a new and interesting suggestion and is worthy of most careful consideration by all who are interested in the general problem of public service control.

Public attention has recently been directed to the very large share of the profits of industry that is at present going to the financier. This is particularly true of the public utility industry. Mr. Whitten states that in this country the financier seems to be getting the lion's share of the profits of public utility enterprises. In England, on the other hand, the services of the financial middleman are in large measure dispensed with thru the sale of new securities at auction or by public tender. Under this method a premium stock is sold at its actual market value and all premium realized is used for betterments and additions to plant. The author discusses at length the advantages and reputed disadvantages of this system of financing. He strongly recommends its adoption. In this, British experience is reinforced by the very favorable experience of the Consumers' Gas Company of Toronto.

In connection with financial manipulation and control Dr. Whitten notes the general absence among English public service companies of the holding company and of the intertwining and interlocking of directorships for the purpose of common control. He suggests that the limited voting power of the large shareholder may be responsible for this condition. In various large public service companies there is a prescribed voting scale and no person no matter how large his holdings can have more than the prescribed maximum of votes (5, 10 or 30).

Effective supervision of public service companies has been promoted more by the enforcement of uniform accounting than by any other single factor. In England the practice has developed of having public service company accounts audited each year by an outside public accountant, elected either by the shareholders or by the Board of Trade. In this country the public service laws often give the state commission authority to audit accounts. This is a valuable power but it is recognized that it is impracticable for a commission to annually audit the accounts of all the companies within its jurisdiction. The author suggests the advisability of requiring each company to have its accounts audited by a qualified outside accountant. The proposed model law submitted by the Department on Regulation of Interstate and Municipal Utilities makes a start in this direction by giving the commission power to require a company to have its accounts certified by a public accountant.

Materials of Engineering Construction at the International Engineering Congress, 1915

Among the general subjects to be treated before the International Engineering Congress, 1915, probably the one having the broadest interest is that of Materials of Engineering Construction, which enters into all phases of engineering activity.

The list of topics which will be treated in this section is as follows:

1. Timber.
2. Preservative Treatment of Timber.
3. Substitutes for Timber in Engineering Construction.
4. Brick in Engineering Structures.
5. Clay Products in Engineering Structures.
6. Probable and Presumptive Life of Concrete Structures Made from Modern Cements.
7. Aggregates for Concrete.
8. Slag Cement.
9. Waterproof Concrete.
10. Cements Containing Additions of Finely Ground Foreign Material.
11. Economics of the World's Supply of Iron.
12. The Life of Iron and Steel Structures.
13. The Employment of Special Steel in Engineering Construction.

14. The Place of Copper in the Present Engineering Field, and the Economics of the World's Supply Thereof.
15. Alloys and Their Use in Engineering Construction.
16. Aluminum in Engineering Construction.
17. The Influence of the Testing of Materials upon Advances in the Designing of Engineering Structures and Machines.
18. Cement Testing.
19. Testing of Metals.
20. Testing Full-Sized Members.
21. Proof Testing of Structures.

The papers to be presented from the United States have already been arranged for from the recognized leading authorities no the various topics. Arrangements for the papers from foreign authors are being rapidly concluded, and the aggregation of papers which will be presented will constitute a broad review of the field and be of the highest value.

Marked interest in the congress from foreign countries continues, and there is every evidence that the attendance from abroad will be large. It is hoped that all engineers in this country who have not yet subscribed as members of the congress will give the matter their immediate attention and favorable action.

Full information concerning the congress, the price of subscription and the arrangement for purchase of volumes of the proceedings may be obtained by addressing the Committee of Management, as follows: International Engineers Congress, 1915, Foxcroft Building, San Francisco, Cal.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places, as follows:

June 17, 18: Mining draftsman in Bureau of Mines, Pittsburg, Pa., at $1,080 to $1,200 a year; mechanical draftsman in Patent Office, Washington, at $1,000 a year; Coast and Geodetic Survey aid at $900 with promotions in grades up to $4,000 a year.

June 17: Expert radio aid in navy yard at New York at $6 a day.

June 29: Senior highway engineer at $2,220 to $3,000 a year, and highway engineer at $1,800 to $2,100 a year, in Office of Public Roads, Department of Agriculture.

July 8, 9: Structural engineer and draftsman in office of supervising architect, Treasury Department, at $1,600 to $1,800 a year; first-class structural draftsman in Panama Canal service at $150 to $175 a month.

Technical Societies

The annual ladies' night of the Engineers' Club of Cincinnati, on Thursday, June 4th, at the auditorium of the University of Cincinnati, is devoted to an address illustrated by motion pictures on "Manufacturing of Tubes," given by a representative of the National Tube Co.

A determined effort is being made by the technical press of the South to bring a large representation to the American Road Congress, to be held in Atlanta, Ga., in November. While there are some very excellent roads in the South, the general average is not high. Special attention will be paid in the program of the congress to these problems of road building under the conditions existing in the southern states.

The Philadelphia convention of the American Water Works Association was one of the largest yet held, over 900 having registered. The features of the convention were the day devoted to the active operators of water works plants, the formation of a section by the chemists and bacteriologists, and the large interesting exhibit of water works apparatus, machinery and materials. A proposition to establish permanent headquarters in New York City was not approved. George G. Earl, of New Orleans, was elected president, and Nicholas S. Hill, Jr., of New York, was elected vice-president. Cincinnati will be the next place of meeting.

The Society for Electrical Development, 29 West 39th street, New York City, has opened a competition to employes of members for the best story, article or report on any subject pertaining to commercial electricity, which closes September 1. There are eight prizes, ranging from $250 to $10.

The Northwestern Road Congress, covering mainly the states of Illinois, Michigan, Iowa, Minnesota, North and South Dakota and Wisconsin, will meet in Milwaukee, Wis., October 28 to 31. One of the principal subjects of discussion will be the lines of interstate roads, such as those proposed for improvement from Chicago to Milwaukee, Milwaukee to the Mississippi river, St. Paul to St. Louis, Milwaukee to the northern Michigan peninsula, the Lincoln Highway, etc.

At its meeting, May 25, the New York Electrical Society heard a lecture by Dr. L. A. Bauer, director of the department of terrestrial magnetism of the Carnegie Institution at Washington, on the non-magnetic yacht "Carnegie" and the general magnetic survey of the oceans now under way. There was also a talk by Lieut. J. C. Porte, of the English navy, on aerial navigation, especially regarding the Redman-Wanamaker trans-Atlantic flight, which will soon be undertaken by Lieut. Porte.

Technical Schools

The School of Commerce, Accounts and Finance of New York University, Washington square, New York, announces a tour thru England for the study of commerce and industry to occupy sixty-five days, sailing from Boston on June 27 and including Liverpool, Chester, the Manchester district, Glasgow, Edinburg, Newcastle, Durham, York, Leeds, Sheffield, Birmingham, Oxford, Cardiff, Bristol, London and several model garden and industrial cities and scenic districts. This is separate from the larger tour of Europe announced last month by the same school.

The Indiana University Extension Division will hold a conference in Bloomington, Ind., on June 8, 9 and 10, on the question "Shall a Constitutional Convention be Called in Indiana," a subject on which a vote will be taken at the November election. A program of addresses by experts upon various phases of the question was arranged under Prof. M. E. Haggerty, chairman of the committee on local arrangements.

Road Bee Day in Michigan

Governor Ferris, of Michigan, following the successful road bee day of the Huron Shore Road Association in Eastern Michigan, on June 9 of 1913, has issued a proclamation asking the people of the state to set apart Thursday and Friday, June 4 and 5, as road bee days, and turn out to work the roads under well-planned and competent supervision. As the Michigan Good Roads Association, the Huron Shore Road Association and the West Michigan Pike Association are behind the movement, and the State Highway Commissioner can be called upon for aid, the movement should be a success. Commissioner Frank F. Rogers has issued a brief letter of instruction to road officials, suggesting methods of organization of the work, work that may be done to advantage and things that should not be done.

Tractor on State Roads

Some states, particularly New York and Pennsylvania, have passed very stringent laws regarding the use of tractors and trailers on the new state highways, some of which have not allowed sufficient time to allow changes in the machines to be made to make them conform to the law. Pennsylvania is trying to bridge over the time by granting special privileges to agricultural outfits, such as threshers, balers and the like, as distinguished from heavy tractors used to haul freight and heavy loads.

The difficulty is with the damage done by tractors heavy enough to haul a line of heavy trailers also loaded. As shown in the article on German tractors and trailers, elsewhere in this number of MUNICIPAL ENGINEERING, this method of hauling loads is very severe on roads that are not hard and level. Single motors or a motor and one trailer are not so troublesome, but the cleats on wheels that have been necessary with the poorer roads of the past are very destructive of the better roads of the present, especially with heavy trailers to haul.

The economics of the case demand that the comparatively few heavily loaded motors and trains shall modify their methods of construction and operation rather than build roads at immense expense which, if sufficient for such loads, will be much more expensive than is necessary for any other class of traffic. The agricultural engine must be changed in design and construction to conform with the necessities of the case, and the motor trucks must be designed to conform also.

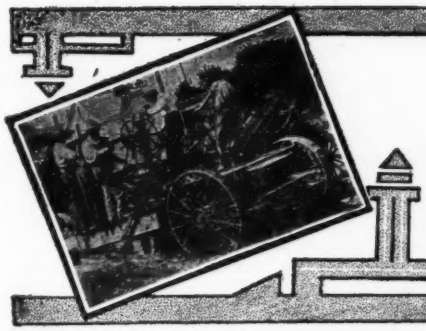
It may be that the laws passed thus far have not been considered sufficiently and are defective. If so, they should be changed and put on a scientific basis before changes in machinery are made which are unnecessary or are not of the right sort to meet the requirements of the highest economy.

Personal Notes

Charles A. Moreno, recently sewer commissioner for the city of St. Louis, Mo., resigned his position to become associated with Seney, Rogers & Co., of Chicago, and to be able to devote attention to his private business.

E. W. Smith has been appointed superintendent of water works at Glens Falls, N. Y. He is also city engineer.

The newly-elected city council of Lufkin, Tex., acting on progressive lines under its new charter of greater Lufkin, covering three times its former area, created an engineering department, which will also have charge of the supervision of buildings, and appointed Col. P. A. McCarthy its city engineer. The new department will have charge of all municipal improvements, which, for the current year, will include street paving, sidewalks, improvements of the water system, including a filter system, and a survey of the whole city. Col. McCarthy formerly served six years as the city engineer under former administrations, and besides conducting a general practice as consulting engineer during the past fourteen years, he handled many important engineering projects in Texas, Oklahoma, Louisiana and New Mexico.



MACHINERY AND SUPPLIES

A Carburetor with One Adjustment

The Huguelet carburetor for Ford cars works automatically, has no springs, has only one adjustment, and can be installed in a half hour. The adjustment mentioned is by means of a thumb screw which is turned to the left for more gas and to the right for less. The claim is made that this carburetor will give more mileage and run slower on high gear than any other. It is made by the Curtis-Ward Company, 28 East Jackson street, Chicago, Ill., who will supply full information concerning it.

A Vacuum Well

A new design in the way of open dug wells, which promises to be of interest and importance to engineers and water works men, is that developed by Mr. J. F. Seiler, of Chicago, concerning installations of which we hope to have reports in the near future.

The design consists primarily of an open caisson carried down into the water-bearing strata, sunk in the usual way. This is lined with a cylindrical steel casing, which is sealed over airtight at about the static head of the underground water. The suction of an ordinary centrifugal or other kind of pump is passed into the so-called water chamber and it is noted that for any water drawn out, there must be an equal amount pass into the chamber on account of the vacuum formed otherwise.

As a rule, where water is not struck until at some distance below its static head, it is possible to seal over the casing below the static head, and if in pumping and drawing in the water, some air passes in, and the head is lowered as a consequence, it is only necessary to stop pumping, open a cock at the top of the casing and allow the water to rise up to its level, the air being forced out.

We understand that the village of Des Plaines, Ill., will install one of these wells under the supervision of Mr. Seiler, and it is estimated the cost of such a well complete will run about $20.00 per foot of depth, giving a capacity up to 1,000,000 gallons per day.

On account of the economic method of pumping which is possible in this well, it is estimated that its entire initial cost will be saved within two years, altho the average consumption of water there will not exceed 100,000 gallons a day.

The Willis-Shaw Machinery Co., Chicago, Ill., are installing these wells, and further information can be obtained from them.

Longer Life For Fire Hose

After many years of experience in the manufacture and use of fire hose, in which he observed the rapid deterioration of the rubber lining, on the lines of the folds in which all hose is stored, Clay Baird has devised a plan of relieving the pressure on the fold which is very simple and effective.

He leaves a band of the rubber lining about the area of the fold free from the fabric of which the hose is manufactured, and cements the tube lining on the flattened areas to the fabric by soft rubber sheet backing, so that it cannot be pulled apart. Then humps at the ends of the flat sides, when in the position of storage, relieve the pressure on the free end areas, so that the rubber takes the form of a circle, approximately, and does not flatten down so as to form a crease at the end. As a consequence the rubber retains the same freedom and elasticity around the area formerly folded down tight that it does in the flat sides and the length of life of the hose is increased to that of the lining as a whole, rather than being limited by being squeezed out along the line of the outside of the fold.

Mr. Baird calls his product bi-lateral lining and the complete hose is bi-lateral hose. Naturally the company selling the hose is the Bi-Lateral Hose Company, tho the goods are manufactured by the B. F. Goodrich Company.

The office of the Bi-Lateral Hose Com-

pany is at 326 West Madison street, Chicago, Ill., where further information can be obtained.

Asphalt Plant in Use on Road Work At the Ashokan Reservoir

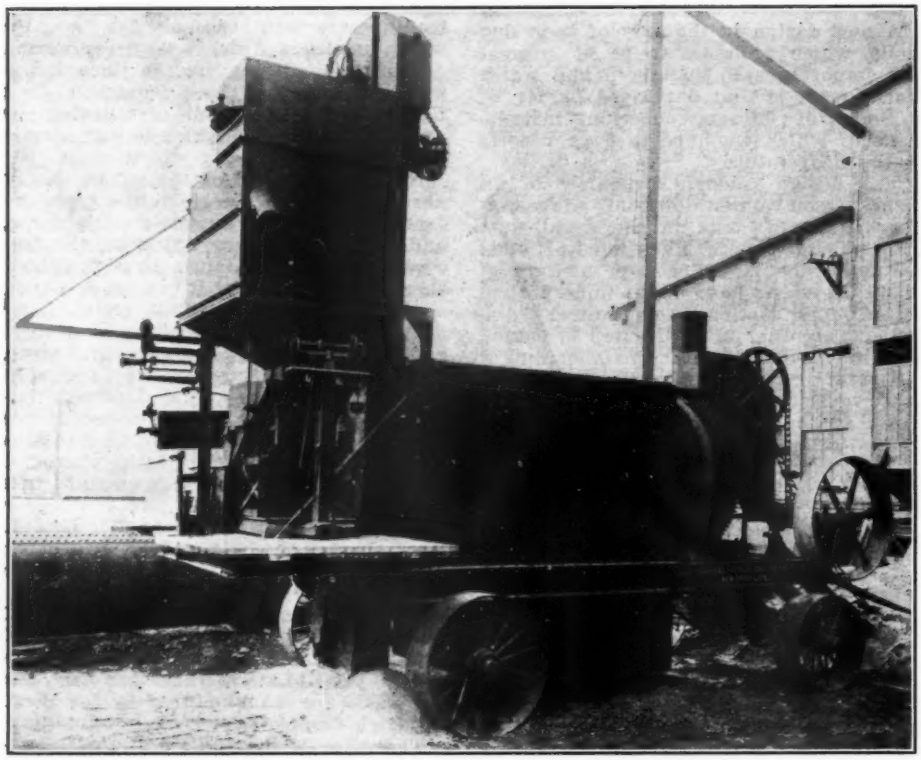
In the construction of an asphaltic macadam roadway, about 32 miles in length, at the new Ashokan Reservoir of New York City, the contractor, the Continental Public Works Company of New York City, is using an asphalt mixing plant of a type recently brought out. The accompanying illustrations show the mixing unit of the plant, which is made in two sizes, one having a capacity of 750 square yards of 2-inch topping per day and the other of 1,000 square yards of 2-inch topping, or an equivalent of asphalt macadam or concrete.

The plant was purchased after a test conducted at the factory in Cleveland. This test was run for one hour and was conducted, using sand and water, which, it is stated, subjected the machine to a test practically equivalent to actual working conditions with the usual materials. The sand contained 7 per cent. of moisture, and an average temperature of 412 degrees F. was obtained at the boot of the drier. During the one-hour test, 10½ tons of mixture were made, which is equivalent to about 1,000 square yards of 2-inch paving mixture per 10-hour day.

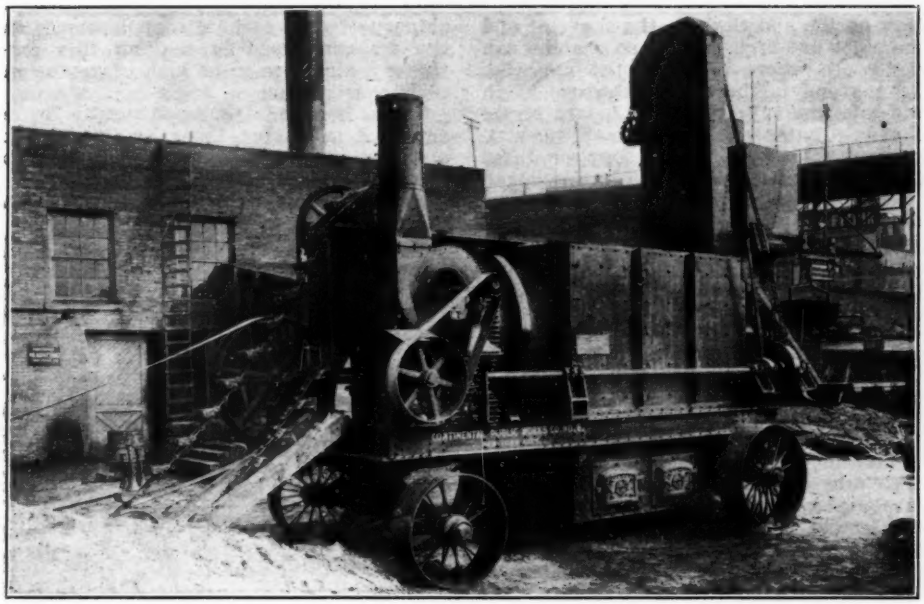
In the following description of the machine the dimensions and capacities given are for the 1,000-yard plant.

The plant consists of three units, the first including the mixing and measuring devices, the second the power plant and the third the asphalt melting kettle. The second unit consists of a 30-horse-power locomotive type portable boiler and a 25-horse-power horizontal engine, mounted together on an all-steel truck. The third unit consists of a portable melting kettle, having a capacity of 10 tons, mounted on an all-steel truck, or two similar kettles of 5 tons capacity each.

The first unit, illustrated herewith, by views of both sides and ends, consists of a sand drum, mixer, sand bin, measuring box and asphalt bucket, with conveying and weighing mechanism, mounted on a steel truck. The sand drum is of the latest Cummer type, having a capacity of 8 tons of sand per hour. The gearing is



CUMMER PORTABLE *asphalt plant in use on road at Ashokan Reservoir, New York City water supply.*



CUMMER PORTABLE *asphalt plant, showing opposite side and end to preceding view.*

of cast steel thruout, and the main bearings are brass-bushed and adjustable. The sand bin has a capacity of 5½ tons, and is equipped with a rotary screen, arranged to permit the mixing of sheet asphalt topping, binder or asphaltic concrete without change. The sand measuring box is on a beam scale and is so arranged that each ingredient can be weighed separately or combined. If desired a 5- cubic foot automatic measuring box can be supplied in place of this. The asphalt bucket is on a double-beam scale, as shown. The mixer is of the batch type with two mixing shafts, and has a capacity of 5 cubic feet.

The trucks are of steel; the front wheels 30 inches in diameter and 12 inches wide, and the rear wheels 36 inches in diameter and 12 inches wide. The plant is driven by a belt from the engine, transmission on the plant being by a main shaft 2 15/16 inches in diameter.

The drum and mixer are connected directly with the main shaft.

The plant can be loaded on a flat car, the top of the bin containing the screen being removed and the upper 4 feet of the elevator, which is hinged, being laid over on its side. When ready for operation the plant is 21 feet over all and 10 feet wide. It requires 20 horse-power to operate it.

The plant is manufactured by the F. D. Cummer & Son Company, of Cleveland, Ohio.

Loss of Time in the Unloading of Stone, Gravel, Sand and Other Materials Is Eliminated

Probably one of the greatest drawbacks the contractor has had to face in securing high efficiency in the unloading of materials from the car to the wagon is the time lost on account of the stalling of teams and idling of drivers.

It is regretfully apparent that this condition obtains generally. We have found that the contractor, in estimating, will often figure 25 to 50 per cent. below the actual cost of unloading from the car. This is no reflection on his ability to estimate, but is due wholly to the fact that he has no time-measure by which to allow for the stalling situation, and his estimate must be based on theoretical cost, which offers no solution of the difficulty.

Happily, however, for the contractor, there is a very simple yet practical solution of the entire problem, as statements which we have from contractors, township trustees and highway commissioners testify. Thomas M. Roche, 829 Monadnock building, Chicago, Ill., is distributer for what is known as the quick unloading car chute. It is a very simple device, as the following description will show:

It is a steel box, attached to the outside of a car, either gondola or box car. It is

open on the end towards the shoveler and the sides are high enough so that he can easily see where to throw the material. On the end farthest from the car is an end-gate, the full width and height of the chute. Chutes are made in ¾-yard, 1-yard and 1½-yard sizes. Two or three chutes full can be dumped into the wagon or automobile, if it happens to be convenient to do so. The chute is made of sheet steel and angle iron, and is hooked over the top of the car side with two large hooks. Two men easily handle a chute. It comes from the factory all ready for use; no assembling of any kind is necessary. A chute weighs from 225 to 325 pounds, according to size. By carrying it to the car in the wagon and setting it down with the hooks up and taking a short lift, the hooks may be placed over the top of the car. When a car is empty the chute may be transferred to a loaded car by placing it on the last wagon load and letting the team draw it along to the next car.

C. D. Buys, highway commissioner of Emmett county, Michigan, states that these chutes have fully demonstrated their efficiency and have proven a good investment for that county in the handling of gravel and crushed stone.

As a factor in the reducing of teaming costs we have the statement of C. L. Baker & Son, contractors, of Quitman, Ga., that "one team will move as much material in a day using these chutes as three teams would previously loading by hand."

The Bitulithic and Contracting Company, Ltd., Grand Forks, N. Dak., explain that they used these chutes last summer, while other contractors in that city followed the old "idle team" method, and "the comparison was so obvious as to be nearly pathetic."

The Canals and Concrete Mixers

One hundred million people are spending $400,000,000 on the Panama canal that will carry 10,600,000 tons.

Eight million people of New York state are spending $100,000,000 on the Erie canal to carry 4,000,000 tons.

Fifty private citizens are spending $12,000,000 on the Cape Cod canal to carry 12,000,000 tons.

Had the fertile brains of the modern mud mixers failed to find the mechanical method for mixing concrete, how much more would these canals cost? This question should set most men thinking of the great importance of the concrete mixer.

In the shadow of this national business of building irrigating dams, canals, railroads, national highways, bridges, dikes, buildings, there is bound to creep in a lot of unreliable makers of machinery—bound to be disappointments in the material used in making this machinery, and sure to be lack of genius in their construction.

There is a wide range of results to be expected in buying these machines, but one fact stands out: It is not easy to equal a Koehring mixer.

Ask the builders, the constructors on the Erie canal. They know.

The Development of Expanded Metal for Reinforcing Concrete Construction

The first steel used in reinforced concrete construction consisted of small round rods. Very shortly after the first concrete construction had been completed, someone conceived the idea of using deformed reinforcing, i. e., bars which had lugs on them or which were twisted so as to grip the concrete more effectively than would the plain bar.

The next step was the production of a fabric reinforcing, which was a considerable improvement over the deformed rods or bars.

The first fabric reinforcing placed on the market was Expanded Metal. This has been perfected so that it now consists of a fabric of steel having diamond shaped meshes 3 inches by 8 inches. Smaller sized meshes are also manufactured, but are not as efficient for reinforcing concrete.

Although the method of manufacturing "Econo" expanded metal is very simple, one of the very best qualities of this fabric is due to this method. The material is expanded cold from sheet steel of different gages varying from No. 16 to No. 7. Gages lighter than 16 are used in producing expanded metal for plastering lath, but do not give a sufficient steel area to be used as reinforcing.

The meshes are formed at one operation, which cuts the steel and also stretches the strands so that the steel forming two sides of each diamond is 2 inches longer in the completed fabric than it was in the original sheet. This stretching increases the strength of the material and has an effect very similar to annealing. It is necessary to use the very

best grade of medium steel in the manufacture of expanded metal, because no other grade will expand without breaking. Medium steel does not have a very high elastic limit, but after it has been manufactured into expanded metal the stretching of the strands increases the elastic limit to approximately 60,000 lbs. per square inch.

Experienced engineers prefer to use this reinforcing because of the fact that the very process of manufacture insures them getting only the very best grade of steel.

The recent rapid increase in the construction of cement pavements and roads has opened a new field for fabric reinforcing. The amount of steel required in this work is very small, yet it is necessary that it should be perfectly reliable and efficient if satisfactory results are to be obtained.

"Econo" reinforcing is furnished in a special weight which is particularly adapted for this class of work. The material is shipped in sheets 4 or 6 feet wide and 8 or 12 feet long, which are sizes that can be easily and quickly placed. The sheets being flat, do not require any straightening out after they are on the job, and one man can not only place all of the reinforcing, but will have time to do a considerable amount of other work.

The flat sheet insures the placing of the reinforcing at proper places in the concrete. Some portion of the reinforcing will not be near the top when it should be at the bottom.

Goodyear Announces Decline in Block Tire Prices

The Goodyear Tire and Rubber Company has just announced a reduction of approximately 5 per cent in the price of Goodyear individual block motor truck tires.

According to advice received from the factory at Akron, this was made possible by the constantly increasing demand for this type of tire by motor truck operators. Raising the production volume lowered the cost to an extent sufficient to warrant a 5 per cent decrease in selling price, which puts the block tire on the same basis as the endless tire. In other words, a truck owner can now buy a block tire at the same price he would have to pay for a demountable or pressed-on tire.

This should be welcome news to many truck operators who have heretofore hesitated to equip with block tires because of their higher price, and also to those who have so equipped in spite of the cost.

Immense success has attended this Goodyear block tire since its introduction on the market about two years ago. It can truly be called "individual." Each block is a unit and is held to the wheel by individual plates and bolts, making it a simple job to remove or replace any block on the wheel without molesting any of the others. A block can be changed in a very few minutes with practically no loss of running time to the truck.

In addition to the above feature, the block tire, of course, has positive traction and non-skid qualities that are not found in any other type of tire.

Some Modern Developments in the Asphalt Industry

The asphalt industry has witnessed many changes during the past five years. The demand for good roads occasioned by automobile traffic is in a large measure responsible, but many other factors have contributed to the increased growth of the industry. A large number of small cities and villages, which at one time were content with slovenly streets, now demand the best type of pavements. This is co-ordinate with the higher standard of living in connection with modern conveniences which the present-day American enjoys and demands.

The application of asphalt to various other industries has also been an important force in the development of the business. For the past two decades asphalt has been increasingly employed in roofing and waterproofing, in mastic floors for railroad station platforms, sidewalks and cellars.

Comparatively new fields for asphalt have been found for insulating, pipe dip and the manufacture of rubber, while additional uses are constantly being discovered in other directions.

For many years asphalt paving was in the hands of a few large companies and it was the prevailing idea that the laying of asphalt pavements was beyond the activities of the ordinary contractor. Today this is all changed. The larger companies have, in part at least, retired from the actual paving business and where once there were only a few asphalt paving contractors, there are now hundreds of firms engaged in this class of work.

Also, the sources of asphalt were limited.

In the past ten years developments have occurred which give the world much greater supplies of asphalt.

The base of asphalt is a very heavy maltha, which is found, amongst other places, in the State of Vera Cruz, Mexico, from twenty to forty miles inland from the Gulf Coast.

The maltha from which Aztec Asphalt is produced is a very heavy, thick material, which, after slight distillation, produces a plastic asphalt. Aztec Asphalt is refined to whatever consistency may be

required to meet the condition for which it is to be used and it is not necessary to add other oils. It is, therefore, really a natural asphalt.

In the special methods followed for refining Aztec Asphalt, the greatest care is taken to produce a material that is uniform and to retain all the essential qualities that nature gave it. The refineries are equipped with all the latest devices of science and with appliances expressly designed to insure perfect control over the refining process.

For paving purposes an asphalt must be a binder. It should be cementitious and tenacious. It must have ductility to provide for expansion and contraction caused by heat and cold.

Ductility is, to a certain extent, coordinate with cementing value and adhesiveness. Asphalt must not be readily affected by the extremes of heat and cold. It must be stable and, therefore, not harden perceptibly when subjected to severe heat. This is important since asphalt when being mixed for paving purposes is subjected to a high heat. Aztec Asphalt possesses these essential properties.

Aztec Asphalt is refined to consistencies suitable for any of the various types of construction, such as sheet asphalt, asphaltic concrete or asphaltic macadam; also for various patented pavements, such as Amiesite, Bitulithic, Warrenite, etc.

Aztec Road Binder is produced especially for the penetration process. This material is ideal for the penetration method, because it leaves upon evaporation ninety per cent. of asphalt in the road, forming a binder that is durable and fully able to withstand the action of the elements and the demands of traffic. It should be borne in mind that Aztec road binder is a straight asphaltic product thruout and does not contain fluxing oils.

Aztec Asphalt is laid in street pavements and roadways in many of the most important sections of the American continent. It withstands the cold in far northern cities and the heat in the southern cities. It withstands the vehicular traffic of the metropolitan cities and that of the motor cars on country roads. It has received unqualified endorsement from all independent asphalt experts and from a host of public officials and contractors who have actually used it.

Aztec Asphalt is laid in sheet asphalt work on some of the most prominent streets in the boro of Manhattan, city of New York, including

72nd street, between West End avenue and Columbus avenue.

38th street, between Broadway and Sixth avenue.

40th street, between Broadway and Seventh avenue.

East and west side of Gramercy Park.

About thirty miles of pavements have been constructed with Aztec Asphalt in Philadelphia during the past two years. In Pittsburgh nearly twenty miles of asphalt re-surfacing work has been laid with Aztec Asphalt during 1913. Among other prominent cities where splendid examples of Aztec Asphalt can be seen are Baltimore, Norfolk, Buffalo, Providence, Chester, Scranton, Detroit, Newark, Paterson and Passaic.

Aztec Asphalt has been laid extensively on the state highways of New York, Pennsylvania and New Jersey.

More than three million square yards of streets and roadways have been constructed during the past two years with Aztec Asphalt.

Aztec Asphalt is making great progress in the southern states; it has been laid in Norfolk and Portsmouth, Va.; Raleigh, Charlotte, Henderson and Lumberton, N. C.; Atlanta, Ga.; Birmingham, Ala., and additional contracts have been closed to lay it in Ginter Park, Va., and Jacksonville, Fla.

A Tractor With a Heavy Load

Notwithstanding the claim in an article on German motor truck trains, elsewhere in this number of MUNICIPAL ENGINEERING, that the motor hauling a train is not successful, and that a motor road train must have motive power on the axles of trailers as well as motor truck, the accompanying photograph shows a Knox-Martin tractor hauling a long string of lumber buggies on a highway, perhaps the longest train and heaviest load ever hauled in this way.

The Standard Lumber Co., of Sonora, Cal., is reported to haul its lumber generally in this way, tho not always in such large quantities in one train.

Durability of Southern Yellow Pine Timber

The "View Plan and Situation of the Church and Churchyard of the Church in Georgia, erected A. D. 1749, and humbly dedicated to the honorable trustees for establishing the Colony of Georgia in America, by the committee appointed for erecting thereof," was recently found in England.

In addition to the above title, there is a sketch of the exterior of the church, the architect's plan and specifications including the following:

"The frame of the church is of wood, so strong (Georgia Southern yellow pine) that it will last for many years; between the studs is a wall of clay 8 inches thick, supported in the center of the clay with pieces of wood 3 inches thick, let into the studs by a groove. The outside is rough cast with lime and gravel, appearing like stone. The inside is plastered, whitewashed and arched; the roof supported by two columns, as per plan, which we propose to have handsomely ornamented."

The old building was moved from its original site, the same as that of Fort Cornwallis, in Augusta, Ga., to the Broad and Pollock street corner, reconstructed and used for commercial purposes until the present time, and is now being demolished. Many of the large Georgia pine timbers are hewn instead of sawn, and the nails are wrought out in a blacksmith shop. Its frame work and timbers are in a remarkable state of preservation still.

Joint Protector for Concrete Pavements

Albert Moyer, New York, is out with a circular descriptive of the Moyer concrete pavement joint plate, whose special feature is a turning down of a strip along the lower edge of the protection plate in sections to form legs about 8 inches long, projecting some 4½ inches below the bottom of the concrete, the legs of the two plates required for each joint being wired together and the tar paper filler being clamped between the plates. These legs are driven into the earth, so that the joint protectors can be set ahead of the concreting and used as guides to the form of the concrete surface.

Trade Notes

The Coldwell Lawn Mower Co., of Newburg, N. Y., has by invitation become a members of the Rice Leaders of the World Association, composed of the leading manufacturers in their respective lines in the world.

The general sales office of the Trussed Concrete Steel Co. is now located at their extensive plant in Youngstown, O., where the closer co-operation of all departments will give even greater efficiency than this excellent organization has developed in the past. A competent engineering and selling organization is retained in Detroit.

As considerable publicity was given last fall to a suit brought by George E. Blakeslee against International Motor Company et al., the company has issued a statement from its office to the effect that on May 14, 1914, Mr. Justice Manning handed down a decision which appears effectively to end the litigation. In dismissing the complaint against International Motor Company, because no facts were shown sufficient to constitute a cause of action against International Motor Company, he says, concerning Mr. Blakeslee, that "his status as a stockholder of the International Motor Company gives him no special privilege not enjoyed by other holders of its shares, and his charges against the latter company fall far short of an actionable complaint for the abuse of fiduciary powers on the part of officers and directors of the International Motor Company. The rights of others are to be conserved and preserved as well as those of the plaintiff, and courts are not prone to attempt the settlement of business policies in the management of corporations except where fraud and gross dereliction of duty is clearly charged and susceptible of proof." The company feels gratified over the satisfactory and conclusive action of the court.

John Baker, Jr., has removed his Chicago office to the Otis Building, 10 South LaSalle street, Room 540.

Trade Publications

The Bituminized Road Co., of Kansas City, Mo., issued a circular descriptive of the national pavement laid on Colborn street, Iola, Kan., by their process.

The annual number of *Contract Record and Engineering Review*, published by Hugh C. McLean, Toronto, Ont., has over 300 pages and seems to cover the Canadian contracting and contractors' mechinery and material field completely, particularly in its advertising pages. A new feature is a reference list of the constructional activities of Canadian cities arranged alphabetically.

"Breaking Home Ties" calls attention to the "Tiger" steel bunks of the Haggard & Marcusson Co., Chicago, Ill.

The Antakwa Company, 403 Chamber of Commerce, Chicago, Ill., have issued a booklet descriptive of their dampproofing, waterproofing and technical paints and telling how to specify them.

Municipal Improvements for 1914.

Following is a classified list of the information regarding improvements during the year 1914, which have been contracted for, or ordered, or are contemplated, which has come to hand since the publication of the April number. This list, added to that in the April number, covers almost every important city which will be active in improvements in 1914, and shows what they now expect to do. Additional work will undoubtedly be done, as the citizens in many cities are quite slow in making their wants known, and many projects do not reach the active stage until quite late in the season.

ROADS AND PAVEMENTS.

Alabama—

Mobile: 20,400 sq. yds. 2-in. asphaltic concrete pavement; 14,200 lin. ft. granite curbing.

Arkansas—

Lonoke: 11 miles macadam road, cost, $60,000.

Paragould: 14,200 sq. yds. brick, 20,800 sq. yds. bitulithic, 12,400 sq. yds. bitustone and 720 yds. gravel.

Star City: 22 miles macadam and gravel roads; cost, $125,000.

California—

Fairfield: 30 miles cement concrete, 5 miles oiled macadam in Salano county.

Marysville: 8½ miles asphalt macadam, 8 miles road grading, 1½ miles cement sidewalks, and 1½ mile concrete curb, in Yuba county.

Placerville: 16 miles waterbound macadam state highway construction, and 4 miles county road grading.

Redlands: 30 miles oiled roads, 1 mile cement sidewalks, 1 mile cement gutter and 1 mile granite curb.

Santa Barbara: 132,000 sq. yds. asphalt, 17,600 sq. yds. gravel and oiled, and 6 miles concrete curb and gutter.

San Jose: 10 miles asphalt, 3 miles asphalt concrete, ¾ mile gravel, 1 mile macadam, 10 miles cement sidewalks, 10 miles concrete curb and gutter.

San Luis Obispo: 2 miles asphalt in city, 60 miles cement concrete, 3 miles gravel, 65 miles road grading and 1 mile cement sidewalks.

Santa Rosa: 70 miles cement concrete and 100 miles road grading in Sonoma county.

Stockton: 2 miles asphalt macadam, 3 miles gravel, 1 mile macadam and 20 miles road grading.

Colorado—

Boulder: 4,000 sq. yds. cement concrete and 14,000 sq. yds. gravel.

Connecticut—

Hartford: Mexican asphalt; cost, $54,000.

Florida—

Jacksonville: 71,700 sq. yds. asphalt concrete, 53,466 sq. yds. brick, 4,826 sq. yds. cement concrete, 12,000 macadam and 26,141 sq. yds. granitoid brick on sand base.

Georgia—

Athens: 20,000 sq. yds. cement concrete, 2 miles cement sidewalks, 5-ft. wide.

Idaho—

Boise: 48,860 sq. yds. asphalt and 4,940 lin. ft. concrete curb.

Illinois—

Alton: 35,000 sq. yds. brick pavements, 2 miles cement sidewalks, 2 miles concrete curb, 5 miles concrete curb and gutter and 15,000 ft. limestone curb.

Cairo: 100,000 sq. yds. asphalt macadam, 40,000 cu. yds. street grading, 10,000 sq. ft. cement sidewalks, 80,000 lin. ft. concrete curb and gutter and 500 lin. ft. limestone curb.

Chicago: 750,000 sq. yds. asphalt, 250,000 sq. yds. asphalt concrete, 350,000 sq. yds. asphalt macadam, 450,000 sq. yds. brick, 60,000 cement concrete, 40,000 granite, 150,000 wooden block, 200 miles cement sidewalks, 30 miles cinder sidewalks, 300,000 lin. ft. concrete curb, 600,000 lin. ft. concrete curb and gutter and 20,000 lin. ft. sandstone curb.

Collinsville: 11,900 sq. yds. vitrified brick paving, 9,200 ft. gravel, concrete curb and gutter.

Danville: 4 miles of brick pavement and 1 mile limestone curb.

Delevan: 32,300 sq. yds. reinforced concrete pavement, 15,900 lin. ft. concrete curb, 11,500 cu. yds. excavation.

Flat Rock: $11,000 to be expended.

Harrisburg: 9,430 sq. yds. vitrified brick paving.

Highwood: 9,300 sq. yds. concrete pavi

Joliet: 40,000 sq. yds. asphalt, 30,000 yds. bituminous macadam, 20,000 sq. yds. brick, 4 miles cement sidewalks and 10,000 lin. ft. concrete curb and gutter.

Mattoon: 15,000 sq. yds. brick, 10,000 sq. ft. cement.

Monmouth: 20 or 30 blocks to be paved

Oak Park: 43,628 sq. yds. asphalt, 130,061 sq. yds. asphalt concrete, 15,924 sq. yds. brick, and 118,215 lin. ft. concrete curb and gutter.

Pana: 14,312 sq. yds. brick pavement, 9,937 lin. ft. curb and gutter.

Rushville: 10,000 sq. yds. brick pavement, 3,120 cu. yds. grading, 6,420 lin. ft. straight combined concrete curb and gutter, 2,921 sq. yds. 6-in. reinforced Portland cement concrete pavement, 2,158 lin. ft. straight concrete curbing.

Sheldon: 3,978 sq. yds. macadam bound with water binder, and 16,645 sq. yds. bound with approved binder.

Springfield: 100,000 sq. yds. brick, 57,000 lin. ft. sandstone pavements, 3 miles street grading in city and 7 miles cement concrete and 150 miles road grading in Sangamon county.

Streator: ¾ mile brick and 2,500 lin. ft. sandstone curb.

Taylorville: 39,994 sq. yds. vitrified block paving and 3,538 sq. yds. reinforced armored concrete pavement.

Indiana—

Bedford: 10 gravel roads in Lawrence county.

Bloomfield: 15,000 sq. yds. brick pavement and 8,300 ft. concrete curb.

Bluffton: 47,000 sq. yds. sheet asphalt.

Crown Point: 6 gravel roads in Lake county.

Elkhart: 28,000 sq. yds. of paving, kind not specified.

Goshen: 3,080 ft. cement concrete and 24 miles gravel road in Elkhart county.

Indianapolis: $200,000 to be expended for street paving.

Kokomo: 13 gravel, stone and brick roads in Howard county.

LaGrange: 350 miles of road grading in county.

Laporte: About 23,000 sq. yds. brick or clay block in city.

Michigan City: 4,000 ft. asphalt, 3,000 relay and widen brick, 6,000 new brick, 1,500 cement concrete, 2,000 ft. sidewalks, 6,000 ft. concrete curb and 8,000 ft. concrete curb and gutter.

Plymouth: Four streets to be paved.

South Bend: 25,000 sq. yds. brick pavement, 10,000 sq. ft. cement sidewalks.
Terre Haute: $500,000 to be expended street paving.
Vincennes: 20,000 sq. yds. brick, 1 mile street grading, 4 miles cement sidewalks, 4,200 ft. concrete curb, 2,000 ft. limestone curb and 2,000 ft. marginal curb.
Winamac: 4,600 cu. yds. brick paving.

Iowa—
Charlton: 32 blocks of paving voted.
Cresco: 24,000 sq. yds. cement paving and 15,500 lin. ft. of curbing.
Harlan: 25 blocks with intersections.
Iowa City: 21 blocks of bitulithic paving and 4 blocks of brick.
Leon: 8,000 sq. yds. brick.
Missouri Valley: 24,850 sq. yds. of pa[illegible] 8,020 lin. ft. curbing.
Nevada: 21,000 sq. yds. concrete, brick or asphaltic concrete pavement.
Pella: 37,700 sq. yds. bitulithic paving, 3,378 ft. curb and gutter.
Buena Vista county.
Storm Lake:
Waterloo: 13 miles road grading in 27,000 sq. yds. asphalt, 52,0[illegible] sq. yds. brick, 5,000 sq. yds. cement concrete, 25,000 lin. ft. cement sidewalks and 5,000 ft. concrete curb and gutter.
Waukon: 21,150 sq. yds. brick paving and 4,600 lin. ft. concrete curb.

Kansas—
Eldorado: 11,473 sq. yds. brick pavement on 4-in. concrete base.
Fort Scott: 20,000 sq. yds. brick pavement, 2 miles street grading, 2 miles cement sidewalk and 1,100 ft. concrete curb and gutter.
Leavenworth: 8,365 sq. yds. vitrified brick pavement and 2,114 cu. yds. excavation.
Manhattan: 3 miles street paving with asphalt.
McPherson: 36 blocks of pavement.
Pittsburg: 26,200 sq. yds. brick pavement. 15,500 ft. concrete curb and gutter and 12,000 cu. yds. excavation.

Kentucky—
Covington: 12,200 sq. yds. asphalt, 6,000 sq. yds. bituminous macadam, 10,000 sq. yds. brick, 8,000 sq. yds. granite, 3,000 sq. yds. wooden block, 6 miles cement sidewalk, 5,000 ft. brick gutter, 10,000 ft. concrete curb and gutter and 20,000 ft. limestone curb.

Louisiana—
Alexandria: 5,000 sq. yds. bitulithic pavement and 26,000 sq. yds. vertical fiber vitrified brick pavement.
Breaux Bridge: 12,000 sq. yds. cement walks with curbing.
Donaldsonville: 19 miles gravel road first road district.
Lake Charles: 12,000 sq. yds. asphaltic concrete pavement and 7,300 lin. ft. concrete curb and gutter.
New Orleans: $500,000 to be expended on state highway construction.

Maine—
Bangor: 3,000 sq. yds. wood block paving.

Massachusetts—
Boston: $500,000 to be expended on suburban street improvements.

Maryland—
Frankfort: 14,500 sq. yds. street pavi concrete curbs and sidewalks; cost, $57,000.

Michigan—
Alpena: 12,000 sq. yds. cement concrete pavement, ½ mile cement sidewalks and 7,000 lin. ft. concrete curb.
Bay City: 300,000 sq. ft. cement sidewalks.
Eaton Rapids: Paving of three streets.
Grand Rapids: 40,000 sq. yds. of brick or clay block, 6,000 sq. yds. concrete and 25,000 sq. yds. bituminous concrete.
Ludington: 11,000 yds. street pavement.
Menominee: 5,000 sq. yds. macadam pavements and 500 ft. concrete curb and gutter.
Saginaw: 2 miles asphalt pavement, 10 miles cement sidewalks, 4 miles brick gutter and 4 miles concrete curb.

Minnesota—
St. Cloud: 9,000 sq. yds. cement concrete, 1,500 sq. yds. cement sidewalks and 30,000 ft. concrete curbs.
St. Paul: 23,588 sq. yds. asphalt resurfacing, 8,780 sq. yds. bituminous concrete, 20,000 sq. yds. of brick, 3,000 sq. yds. cement concrete, 8,690 sq. yds. sandstone block, 242,027 sq. yds. creosoted wooden blocks, 15 miles street grading, 75,000 lin. ft. cement sidewalks and 87,754 lin. ft. concrete curb.
Thief River Falls: 1,377 cu. yds. grading, 26,600 lin. ft. turnpiking and 5,000 cu. yds. of gravel in county.
Walker: 23 miles state rural highway.

Mississippi—
Clinton: 2,000 yds. concrete sidewalks.
Vicksburg: 2 miles cement sidewalks.

Missouri—
Boonville: 15,000 sq. yds. brick or clay block pavement and 14,000 sq. yds. concrete.
Hannibal: 10,000 sq. yds. asphalt macadam, 2,000 cu. yds. bitulithic, 2,000 sq. yds. brick, 40,000 sq. yds. cement concrete pavement, 2 miles street grading, 8 miles cement sidewalks and 3 miles concrete curb and gutter.
Kansas City: 9 miles asphalt concrete, 4½ miles asphalt macadam, 4 miles brick, 15 miles cement concrete, 2½ miles sandstone, 4 miles wooden block, 30 miles street grading and 36 miles cement sidewalks, 34 miles concrete curb and 3½ miles concrete curb and gutter.

Montana—
Butte: 24,300 sq. yds. bitulithic pavement, 130,000 cu. yds. grading, 7 miles cement sidewalks.
Helena: 32,000 sq. yds. bitulithic, 40,000 sq. yds. brick, 25,000 cu. yds. street grading, 200,000 sq. ft. cement sidewalks, 50,000 lin. ft. concrete curb.
Philipsburg: 3 miles gravel road construction in county.

Nebraska—
Dundee: 25,000 sq. yds. asphalt, 14,500 lin. ft. cement curb and 2,400 lin. ft. stone curb.

New Hampshire—
Laconia: 5,000 sq. yds. bituminous and 1,000 ft. granite curb.

New Jersey—
Bayonne: 5,000 lin. ft. cement sidewalks, 5,000 lin. ft. stone sidewalks, ½ mile concrete curb, 2 miles Bluestone curb, ½ mile concrete curb and gutter.
Bloomfield: 1 mile asphalt, 1 mile asphalt macadam, 2 miles granite pavements, 2 miles cement sidewalks, 2 miles stone sidewalks, 2 miles concrete curb and gutter and 5 miles Bluestone curb.
New Brunswick: $50,000 to be expended on concrete, asphaltic concrete and brick pavements.

New Mexico—
Albuquerque: 3,000 ft. cement sidewalks.

New York—
Brooklyn: 606,800 sq. yds. sheet asphalt, 180,954 sq. yds. granite, sandstone or other stone block, 17,000 sq. yds. creosoted wood block, 5,700 sq. yds. of other pavements.
Cortland: 1,500 ft. bituminous macadam, 12,000 yds. brick, 2,000 ft. oiled macadam, 4,000 ft. sandstone curb and 3,000 ft. sandstone curb and gutter.
Fonda: 4 miles of gravel, 3 miles macadam road construction and 120 miles road grading in Montgomery county.
Johnstown: 4,000 sq. yds. asphalt block, 8,000 sq. yds. bituminous macadam, 10,000 sq. yds. oiled macadam, 2 miles brick

sidewalks, 4 miles cement sidewalks, 17,000 ft. concrete curb.
Troy: 6,000 sq. yds. asphalt, 22,560 sq. yds. bitulithic, 32,190 sq. yds. brick, 21,400 sq. yds. granite relaid, 6,000 ft. Hassam, 9,000 sq. ft. cement sidewalks, 17,000 lin. ft. concrete curb.
Utica: 30,000 sq. yds. asphalt, 17,000 sq. yds. asphaltic concrete, 44,000 sq. yds. bitulithic, 2.5 miles cement sidewalks, 11,000 lin. ft. concrete curb and gutter and 11,000 ft. sandstone curb.

North Carolina—
Charlotte: 70,000 sq. yds. asphalt, 30,000 sq. yds. cement sidewalks and 5 miles concrete curb.
Durham: 20,000 sq. yds. bituminous macadam, 17,000 sq. yds. street grading and 17,000 ft. concrete curb and gutter.

North Dakota—
Grand Forks: 2 miles cement sidewalks and 4 miles concrete curb.

Ohio—
Akron: 15 miles brick, 1 mile wooden block, 30 miles cement sidewalks, 15 miles concrete curb and gutter and 15 miles sandstone curb.
Centerburg: 13,300 sq. yds. brick paving and 8,000 ft. stone curb.
Chardon: 5 miles concrete road construction and 5 miles road grading in county.
Chillicothe: 5,100 sq. yds. brick pavement, 16,000 sq. ft. cement sidewalks and 3,500 ft. concrete curb.
Cincinnati: 8,100 sq. yds. asphalt, 38,700 sq. yds. bituminous macadam, 95,000 sq. yds. brick, 83,000 sq. yds. granite, 29,800 sq. yds. gravel, 58,560 sq. yds. wooden block, 18 miles street grading, 200,000 sq. ft. cement sidewalks, 38,280 lin. ft. concrete curb and 80,000 lin. ft. granite curb.
Dayton: 1 mile bituminous macadam, 8 miles brick, 30 miles gravel and 8 miles road grading in county.
Elyria: 35,000 sq. yds. street pavements and 26,200 ft. concrete or stone curbs.
Ironton: 3 miles of brick construction, 5 miles cement sidewalks.
Massilion: 250,000 sq. yds. brick or clay block and 2,500 sq. yds. gravel.
Sandusky: 12,000 sq. yds. asphalt, 20,000 sq. yds. brick, 7,000 sq. yds. cement concrete, 10,000 cu. yds. street grading, 15,000 sq. ft. cement sidewalks, 4,000 sq. ft. stone sidewalks, 6,000 lin. ft. concrete curb, 8,000 lin. ft. concrete curb and gutter and 5,000 lin. ft. sandstone curb.
Steubenville: 2 miles of brick, 40,000 sq. yds. street grading, 3 miles cement sidewalks, 4 miles concrete curb and gutter and 1,000 lin. ft. sandstone curb.
St. Paris: $30,000 to be expended.
Urbana: 22,500 sq. yds. pavement.
Versailles: 10,100 sq. yds. brick pavement; cost, $36,000.
Woodstock: $3,000 to be expended on macadam pavement.

Oklahoma—
Arnett: 4 miles gravel road construction, 1,000 ft. cement sidewalks, 1,000 ft. concrete curb in Ellis county.
Collinsville: 34,000 sq. yds. brick or asphalt pavement.
Marietta: 20,000 sq. yds. bitulithic.
Tulsa: 15,000 ft. cement sidewalks, 5 miles asphalt pavement and 1½ miles asphalt concrete pavement.

Ontario, Can.—
Jarvis: 10,624 sq. yds. street paving.
Stratford: 12,000 sq. yds. concrete pavement and 12,650 lin. ft. concrete curbing.

Oregon—
Portland: 29,575 lin. ft. asphalt, 27,550 lin. ft. asphalt concrete, 8,960 lin. ft. bitulithic, 33,560 lin. ft. gravel, 43,802 sq. yds. brick, 12,000 lin. ft. cement concrete, 22,000 lin. ft. Hassam, 34,000 lin. ft. stone blocks, 23,000 lin. ft. bitulithic redress, 100,882 lin. ft. street grading, 1,104,522 sq. ft. cement sidewalks and 378,173 lin. ft. concrete curb.

Pennsylvania—
Allentown: 70,000 sq. yds. asphalt, 30,000 sq. yds. bituminous concrete, 1,000 sq. yds. brick, 1,800 sq. yds. granite, 9,000 cu. yds. street grading.
Beaver Falls: 4,000 sq. yds. paving and 2,400 ft. curbing.
Kingston: 5,500 sq. yds. brick pavement, and resetting 2,100 lin. ft. stone curb.
St. Marys: 9,000 sq. yds. vitrified brick, 1,000 lin. ft. concrete curbing, 9,000 lin. ft. concrete edging.
Williamsburg: 15,000 sq. yds. reinforced concrete and 7,600 lin. ft. concrete curb.
York: 4 miles pavement, 65,000 sq. ft. cement sidewalks and 8 miles concrete curb and gutter.

Porto Rico—
Ponce: 2 miles asphalt, 2 miles bituminous concrete, 25 miles road grading, 8 miles concrete curb.

Saskatchewan, Can.—
Regina: 113,000 sq. yds. pavement.

South Carolina—
Charleston: 60,000 sq. yds. creosoted wood block, sheet asphalt or asphaltic concrete.
Greenville: 5,000 sq. yds. sidewalk pavement.
Sumter: 5,550 sq. yds. Bessemer pavement.

South Dakota—
Sioux Falls: 50,000 sq. yds. either cement, concrete or granite; 30,000 cu. yds. street grading, 6,000 lin. ft. cement sidewalks and 10,000 lin. ft. concrete curb.
Watertown: 22,500 sq. yds. Portland cement concrete, vitrified brick, asphaltic concrete or creosoted block pavement.

Tennessee—
Knoxville: 60 miles road grading and macadamizing, 30 miles.

Texas—
Austin: 3,250 sq. yds. asphalt concrete, 16,268 sq. yds. bitulithic, 5,000 sq. yds. cement concrete, 10 miles cement grading, 37,304 lin. ft. cement sidewalks and 41,409 lin. ft. concrete curb.
Belton: 80 miles road work in Bell county.
Houston: Paving of 12 streets.
Liberty: 20 miles shell road; cost, $100,000.
Marshall: 15 miles bituminous macadam, 5 miles concrete curb and 5 miles concrete curb and gutter.
Mart: 17,400 sq. yds. pavement and 4,560 lin. ft. combined curb and gutter.
McKinney: $200,000 to be expended.

Utah—
Salt Lake City: 64,000 sq. yds. asphalt, 2½ miles bitulithic, 1 mile cement concrete, 20 miles brick and cement sidewalks and 22 miles concrete curb and gutter.

Vermont—
Rutland: 1 mile brick, 2 miles gravel, 2 miles macadam, 1 mile tar concrete sidewalks and 2 miles stone sidewalks.

Virginia—
Fairfax: Grading and graveling 32 miles state highway.

Washington—
Asotin: 1 mile cement concrete road, 1,000 ft. cement sidewalks, 5 miles road grading in county.
Everett: 4 miles cement concrete, 5 miles gravel, 30 miles road grading in county.
North Yakima: 10,000 sq. yds. asphalt concrete, 2,000 sq. yds. macadam and 2,000 ft. concrete curb and gutter.
Olympia: 12 miles gravel and 10 miles road grading in county.
Pasco: 7 miles highway construction and 5 miles graded roadway.
Seattle: 54,000 sq. yds. brick road construction and 75 miles road grading.
Walla Walla: 40,000 sq. yds. bitulithic, 4

miles concrete curb and gutter and about 2 miles hard surface pavement.
Waterville: 5 miles gravel, 4 miles macadam and 18 miles road grading in Douglas county.
Wenatchee: 20 miles gravel roads construction and 20 miles road grading in county.

West Virginia—
Charleston: 10 miles macadam road construction in Jefferson county.
Marlinton: 2½ miles macadam, 1 mile of oiled macadam in Pocahontas county.
Parkersburg: 3½ miles brick, 20,000 sq. yds. cement sidewalks and 25,000 ft. concrete curb.
Proctor: 115 miles road grading, 1,200 sq. yds. brick sidewalk construction in Wetzel county.
Sisterville: 7,500 sq. yds. brick pavement, 5,350 lin. ft. concrete curbing.

Wisconsin—
Eau Claire: 9,400 sq. yds. asphalt macadam, 1,000 sq. yds. brick, 3,500 sq. yds. cement concrete, 1,700 sq. yds. wood block and 3,000 lin . ft. concrete curb and gutter.
Fond du Lac: 15,279 ft. cement concrete, 30,000 ft. concrete curb and gutter and 6 miles cement sidewalks.
Janesville: 4,224 sq. yds. asphalt macadam, 7,020 sq. yds. macadam, 4½ miles concrete curb, 1½ miles cement sidewalks.
Lake Geneva: 21,000 sq. yds. creosoted wood block pavement.
Rice Lake: 20 miles road grading in Barron county; cost, $38,000.
Richland Center : 4 blocks concrete pavement.
Sparta: 1 mile cement concrete, 16 miles macadam, 7 miles oiled macadam and 20 miles road grading in Monroe county.

SEWERS.

Alabama—
East Lake: 4 or 5 miles sanitary sewer; cost, $17,500.
Mobile: 19,500 ft. storm sewers, 36 manholes, 60 inlets, 12 special basins.
Opp: Sanitary sewer system.
Thomasville: Sewer system; cost, $8,000.

Arizona—
Tempe: Vitrified pipe sewer system; cost, $32,000.

California—
Berkeley: Four sections of sewers.
El Centro: Outfall sewer for El Centro and Imperial.
Los Angeles: Sewer system; cost, $662,000.
Reedley: Sewer system; cost, $27,768.
Sanger: Sewer and water system; cost, $56,000.
San Jose: 1 mile reinforced concrete and 1 mile vitrified pipe sewers.
Santa Barbara: 3 miles vitrified pipe and 30 manholes.
South Pasadena: Sewer system; cost, $51,476.

Connecticut—
Hartford: Sewer system.

Georgia—
Augusta: Changing courses of sewers at four streets; cost, $100,000.
Jackson: Sewer system; cost, $13,400.

Idaho—
Lewiston: Sanitary sewer in District No. 4; cost, $28,500.

Illinois—
Alton: 1,662 ft. 6-in. house connections, 973 ft. 8-in. pipe, 410-ft. 10-in. pipe, 1,206 ft. 12-in. pipe, 800 ft. 15-in. pipe, 13 manholes, 18 catchbasins, 2 inlets, 1 lamp hole. Sanitary Sewer District No. 2—32,400 lin. ft. 6-in. house connections, 38,730 lin. ft. 8-in. pipe, 11,440 lin. ft. 10-in. pipe, 1,160 lin. ft. 10-in. pipe, 6,500 lin. ft. 12-in. pipe, 4,503 lin. ft. 15-in. pipe, 1,460 lin. ft. 12-in. cast iron pipe, 1,430 lin. ft. 16-in. cast iron pipe, 144 manholes, 21 flush tanks and 18,400 lin. ft. of repaving trenches.
Centralia: Seventh South Street Sewer District—2,680 lin. ft. 12-in. vitrified clay sewer pipe, 900 lin. ft. 10-in. clay sewer pipe, 4,460 lin. ft. vitrified clay sewer pipe, 7,220 cu. yds. excavating and refilling trenches and 20 brick manholes with cast iron covers.
Chicago: Sewers in various streets.
East Moline: Sewers in Watertown addition; cost, $13,600.
East St. Louis: Rebuilding Illinois street sewer; cost, $13,700.
Elgin: Sewer system; cost, $437,000.
Gridley: Sanitary sewer system; cost $10,000.
Joliet: About 3 miles vitrified pipe sewers.
Peoria: South end sewer system; cost, $636,137.50.
Rankin: Sewer construction; cost, $14,660.
Springfield: 10,800 lin. ft. brick sewers, 10,000 lin. ft. 18-in. vitrified pipe and 60 manholes.
Toulon: Sewer system; cost, $20,000.

Indiana—
Angola: Sewer system for north side and District No. 22; cost, $43,000.
Chesterton: Sewer system; cost, $19,000.
Connersville: Vitrified tile sewers.
Fort Wayne: Sewers in various streets.
Greencastle: Sewer system; cost, $60,000.
Huntington: Vitrified clay tile sewers.
Indianapolis: Sewers; amount indefinite.
Knox: Three sewers across Gold ditch in Stark county.
LaPorte: One sewer district.
Michigan City: 7,500 ft. brick, 9 ft. to 3 ft., 6-in.
Middletown: 2.61 miles 8-in. to 18-in. vitrified pipe sewers, cut 5 ft. to 16 ft.
Muncie: Sewers; amount indefinite.
Peru: Sewers in various streets.
Richmond: Sewer system in Morton Park, about 2¾ miles 8-in. to 24-in. diameter.
Thorntown: West end sewer system.
South Bend: 5,000 ft. of 8, 10, 12, 15 and 18-in. vitrified pipe sewers.
Vincennes: Storm water sewer; length, 9 miles; cost, $47,310.
Winchester: Sanitary sewer.

Iowa—
Burlington: Extension of Hawkeye sewer and construction of Prospect Hill storm and sanitary sewer.
Dubuque: Sanitary sewer.
Osage: Sewer system; cost, $96,000.
Guthrie Center: Sewer system; cost, $40,000.
Sioux City: Storm water sewers.
Sumner: 4 miles sewers.

Kansas—
Council Grove: 23,800 ft. lateral sewers; cost, $16,000.
Dodge City: Sewer construction; cost, $13,964.
Fort Scott: 3 miles vitrified pipe and 50 manholes.
Pratt: Sewer system; cost, $4,000.

Kentucky—
Covington: 1,100 ft. 7x9 ft. concrete plain, 2,500 ft. vitrified block, 5,000 ft. vitrified pipe, 60 manholes and 180 catchbasins.
Paducah: Sewer District No. 3; cost, $200,000.

Maryland—
Baltimore: Sanitary sewers.
Frederick: 2,110 ft. brick, 1,860 ft. vitrified block, 7,600 ft. vitrified pipe sewers, 14 manholes and 20 catchbasins.

Massachusetts—
Boston: Sewers for Davenport brook.
Fitchburg: Sections 5 and 6 of intercepting sewer.
Franklin: Sewers; amount indefinite.

Michigan—
Highland Park: Sewers; amount indefinite.
Ludington: 6,000 ft. trunk sewer, either brick, concrete or segment block tile.
Lyons: Sewer system in business district.
Menominee: 3,000 ft. vitrified pipe, 6 manholes and 7 catchbasins.
Otsego: Sanitary sewers with laterals.
Saginaw: 4 miles, mostly 12-in. concrete pipe sewers.

Minnesota—
Austin: 4,074 ft. 8-in., 766 ft. 12-in., 1,785 ft. 15-in. and 672 lin. ft. 18-in. sanitary sewers.
Mankato: 1,700 ft. reinforced concrete, 2,000 ft. vitrified pipe sewers, 15 manholes and 5 catchbasins.
Ortonville: Sewer system; cost, $11,000.
St. Paul: 40 miles of sewers, from 9-in. to 78-in.; cost, $560,000.

Montana—
Butte: 400 lin. ft. reinforced concrete, 9,000 lin. ft. 8-in. concrete and vitrified pipe sanitary sewers, 35 manholes and 15 catchbasins.
Fort Benton: Sanitary and storm sewer system.

Missouri—
Caruthersville: Sewer system; cost, $40,000.
Hannibal: Sewer District No. 300; cost, $30,000, including 4,000 ft. concrete plain, and 70,000 lin. ft. vitrified pipe sewers.
Poplar Bluff: Vitrified pipe sewers in District No. 4, 35,439 ft.; cost, $22,000.
Webster Grove: 19,200 ft. 8, 10, 12-in. sewers; cost, $20,000.

Nebraska—
Fremont: Sewer main, length 6,800 ft., cost $10,000.
Laurel: Sewers, amount indefinite.

New Jersey—
Bloomfield: 5 miles vitr. pipe, 50 manholes and 10 catchbasins.
Newark: Sewers in various streets.
Plainfield: 17 miles 16-in. c. i. pipe, 1.3 miles 27-in. vitr. pipe and 20 manholes.
Ventnor City: 3,460 lin. ft. intercepting sewer and 8,300 lin. ft. 14-in. c. i. sewage force main.

New York—
Brighton: Sewers in District No. 1.
Cortland: 1,500 ft. 8-in. vitr. pipe.
Elmira: 11 sewers.
Glen Cove: 15 miles vitr. pipe sewers, 6-in. to 15-in.
Holly: 6½ miles pipe sewers.
Johnstown: 1 mile 8-in. vitr. pipe and two catchbasins.
Troy: 10,000 ft. vitr. pipe, 300 manholes, 125 catchbasins.
Utica: 5,000 lin. ft. 8-in. to 15-in. vitr. pipe sewers, 20 manholes, and 45 catchbasins.
Wappingers Falls: Sewer system.
Yonkers: 12 sewers.

North Carolina—
Durham: 20,000 ft. 8-in. to 12-in. vitr. pipe sewers.
Mooresville: $100,000 to be expended in sewer improvements.

North Dakota—
Grand Forks: 1 mile vitr. pipe sewers, 10 manholes and 6 catchbasins.

Ohio—
Akron: 2,000 ft. 6-in. vitr. pipe, and 500 ft. 10-in. vitr. pipe, 12 manholes, 6 catchbasins.
Bucyrus: $15,000 to be expended on sewers in various streets.
Cincinnati: 41,900 lin. ft. brick or concrete plain, 59,000 lin. ft. vitr. pipe and 11,320 ft. other types.
Chillicothe: 670 ft. vitr. pipe laterals, 20-15-18-in., 2 manholes, 9 catchbasins.
Dayton: Sewers in sewer district No. 6.
Findlay: 2 miles 10-in. and 24-in. vitr. pipe sewers, 51 manholes, and 112 catchbasins.
Kenmore: Sewer system, cost $113,163.
Kingston: 775 ft. 18-in. sewer pipe.
Lancaster: $12,000 to be expended on storm sewers.
Lowellville: Sewer system, cost $19,000.
Maumee: Main and outlet sewers in Key St. sewer district.
Newcomerstown: Sewer system for principal streets, cost $72,500.
Sandusky: 7,000 lin. ft. 36-in. brick, 4,000 lin. ft. 36-in. concrete plain, 1,000 lin. ft. 36-in. concrete reinforced, 4,000 lin. ft. 30-in. vitr. block, 10,000 lin. ft. 12-in. to 24-in. vitr. pipe, 125 manholes and 200 catchbasins.
Steubenville: 1 mile vitr. pipe sewers, 30 manholes and 60 catchbasins.
Toledo: Two new sewer districts.

Oklahoma—
Tulsa: 10,000 ft. 8-in. vitr. pipe sewers.
Sulphur: 54,700 ft. 6-in., 3,900 ft. 8-in. pipe sewers, 118 manholes, and 1,160 yds. rock excavation, cost $50,000.

Pennsylvania—
Carlisle: 2,000 ft. vitr. pipe sewers.
Harrisburg: $85,000 to be expended on sewer construction.
Meadville: Sanitary sewers.
Norwood: Branch terra cotta pipe sewers.
Reading: Sewer construction Section 1 and 2.
Sunbury: System of intercepting sewers.
Westchester: 20,000 ft. lateral sewers 8-in., 10-in. and 12-in. terra cotta.
York: Sanitary and storm sewers.

South Carolina—
Lancaster: 11 miles 8 to 15-in. sanitary sewers.

South Dakota—
Armour: Sewer system.
Britton: 4 miles sewers.

Tennessee—
Chattanooga: Sewer system in eleventh ward, cost $13,000.
Greenville: Sewer system, cost $30,000.

Texas—
Houston: Storm sewers.

Utah—
Salt Lake City: Main outlet sewer, length 18,000 ft., cost $270,000; 8-in. to 30-in. concrete pipe and vitr. pipe sewers, cost $1,500,000.

Vermont—
Rutland: 1 mile plain concrete sewers.

Washington—
Centralia: 2 miles trunk sewer with laterals, cost $150,000.
Walla Walla: 1½ miles vitr. pipe sewers, 25 manholes.

Wisconsin—
Chippewa Falls: Main street sewer, cost $11,000.
Fond du Lac: About 3 miles vitr. pipe sewers.
Merrill: 3,000 ft. 48-in. reinforced concrete sewers, cost $30,000.

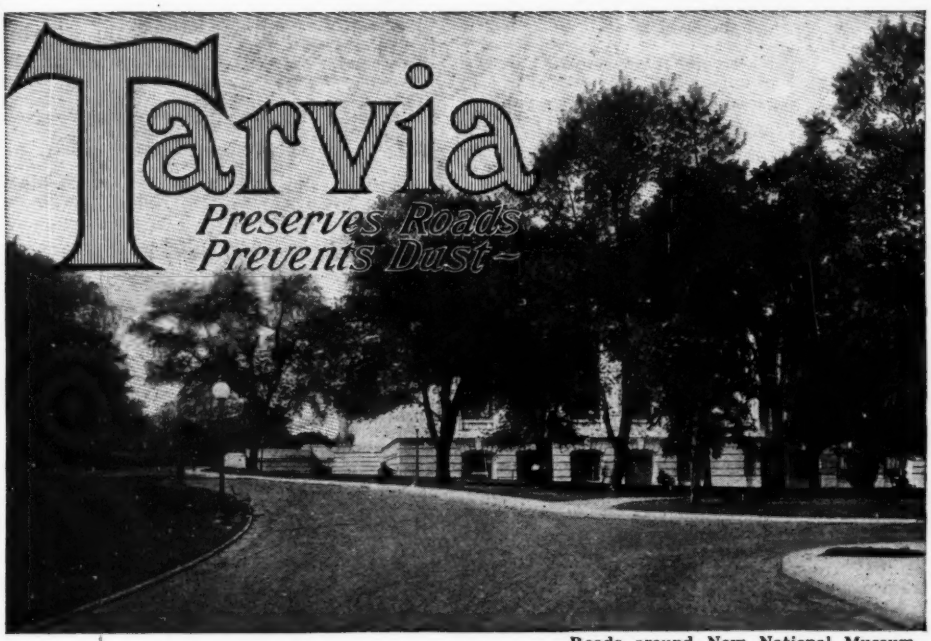
SEWAGE DISPOSAL PLANTS.

Indiana—
Greencastle: Sewage disposal plant, cost $5,000.
Kendallville: Sewage disposal plant.

Iowa—
Sumner: Sewage disposal plant, cost $15,000.
Greene: Sewage disposal plant.
Waterloo: Sewage disposal plant, cost $13,000.

Massachusetts—
Boston: Sewage works for Davenport Brook.

Michigan—
Cadillac: Sewage disposal plant, 3 septic



Roads around New National Museum, Washington, D. C. Constructed with "Tarvia X".

This road is three years old—

HERE is a Tarvia-built road that for three years has carried the heavy traffic of sightseers to the New National Museum in Washington.

Ordinary macadam would have lasted but a few months in this location.

The addition of "Tarvia X" as a binder, when the road was constructed, has been sufficient to keep the surface in splendid condition for three years, with the prospect of very little maintenance expense in the near future.

Tarvia is a dense, viscid coal tar product of great bonding power. It introduces an element of plasticity in the roadway and binds the stone in a tough matrix. Internal friction under heavy loads is prevented. Water runs off the surface instantly, and the tarviated macadam will not ravel on slopes. The surface is automobile-proof, producing no dust.

Tarviated macadam in the end costs no more than ordinary macadam—its first cost is a little higher, but its maintenance cost is very much lower.

Tarvia is made in three grades: "Tarvia X" is suitable for building Tarvia-macadam roads; "Tarvia A" and "Tarvia B" are thinner grades suitable for roads already in use, to preserve them and make them dustless.

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TRADE B MARK

tank units, 6 contact filter units, one sludge bed, cost $27,000.
Highland Park: Sewage plant, cost $39,000.

Nebraska—
Laurel: Sewage disposal plant.

New Jersey—
Ventnor City: Sewage disposal works.

New York—
Brighton: Disposal plant for sewer district No. 1.
Glen Cove: Sewage disposal works.
Holley: Sewage disposal works.
Rochester: Sewage disposal plant in Irondequoit, cost $333,855.

Ohio—
Canton: Sewage disposal plant.
Delphos: Sewage treatment plant.
New Philadelphia: Sewage disposal works.
Urbana: Sewage treatment plant.

Pennsylvania—
Elwyn: Sewage disposal plant consisting of Imhoff tank, etc.

South Dakota—
Britton: Sewage treatment plant.

WATER WORKS.

Arizona—
Wickenburg: Water works system, including 100,000 gal. reinforced concrete water tank, 1,600 ft. 6-in., 8,000 4-in. pipe, and 2,000 2-in. galvanized pipe. 25 h. p. gasoline engine, 4-in. 2-stage centrifugal pump, 13 hydrants, gate valves, connections, etc.

California—
Montague: Water works system, cost $20,700.
Reedley: Extension of water system, cost $12,000.

Colorado—
Lamar: 2 miles water mains.
Walsenburg: Water works, cost $22,000.

Florida—
Jacksonville: Remodeling and extending pumping station.
Wauchula: Water works system.

Georgia—
Ball Ground: Water works plant.
Milledgeville: Water works system.

Illinois—
Carpentersville: Water works system, cost $20,000.
Deerfield: Water works system, cost $11,600.
Freeburg: Water works system.
Joy: Water works system, cost $21,000.
Kincaid: Water works distribution system.
Princeville: 22,350 ft. 4, 6, 8-in. pipe, 43 hydrants and valves.

Indiana—
Beech Grove, Indianapolis: Water works system.

Iowa—
Coin: Water works system, bond issue $12,000.
Des Moines: Water works system.
Mitchellville: Water works system.
Slater: Water works, cost $10,000.
Valley Junction: Water works system, cost $33,000.
Woodbine: Water works improvement.

Kansas—
Arkansas City: Water works and improvement extensions, cost $86,000.
Council Grove. Water works improvements.
Derby: Water works system.
Esbom: Water works plant.
Jetmore: Water and light plant.
Larned: Water works.
Manhattan: $10,000 to be expended on a water works improvements.

Louisiana—
Hammond: Water system.

Kentucky—
Campbellsville: Water works system, cost $35,000.
Sebree: Water works system.

Massachusetts—
Duxbury: Water system including 14 miles mains.

Michigan—
Grandville: Water works system, cost $12,000.
Highland Park: Water supply system, including 3,000 ft. 36-in. intake pipe, 1 submerged crib, 58,200 ft. 36-in. supply pipe, trenching, laying, back filling, etc.
Midland: Water works system.

Minnesota—
Alexandria: Water works system.
Hibbing: Improvement to water system, cost $950,000.
St. Paul: Improvement to water system.
Sanborn: Water works system.

Mississippi:
Tunica: Water works system including 50,000 gal. tank, etc.
Vicksburg: Water works plant.

Montana—
Columbus: Water works to be c. i. distributing system with 8-in. steel pipe.

Missouri—
Butler: Water works plant.
LaGrange: Water works system.

Nebraska—
Bruning: Water works system and light plant.
Dorchester: Water system, cost $13,000.
North Loup: Water works and electric light system, cost $19,300.

New Jersey—
Allendale: Water works system, cost $37,000.
Moorestown: Water works improvement.

New Mexico—
Raton: Water works system.

New York—
Arkport: Water works system.
Buffalo: Treatment plant for water supply.
Lackawanna: Water works system, cost $250,000.
Red Creek: Water works system, cost $25,000.
Rochester: 8 miles 27-in. c. i. pipe.
Sea Breeze: Water works system including 6 miles 6-in. and 4-in. c. i. pipe, hydrants and valves.
Sidney: Water works system, cost $125,000.
Williamson: Water works system, cost $27,900.

North Carolina—
Asheville: Water system.

Ohio—
Columbus: Alum plant for water purification works.
Granville: Water works and light plant.
Springfield: Purification plant.

Oklahoma—
Henryetta: Water works improvement to cost $20,000.
Morris: Water works system, bond issue $42,000.

Ontario, Can.—
Lambeth: Water works system, cost $10,000.
Leaside: Water works system.

Pennsylvania—
Harrisburg: Water works system.

South Carolina—
Mt. Pleasant: Water works system, bond issue $18,000.

South Dakota—
Veblen: Water works system.

A STANDARD OF EXCELLENCE

in any field is decided and set by the concensus of opinion among the buyers not the sellers.

IN THE PAVING FIELD

Ask the present and former cities who have used it what they think about

BITULITHIC

The greatest care is used in the construction of the **Bitulithic** pavement. It renders unfailing service. **Bitulithic** is made of varying sizes of the best stone obtainable combined with bituminous cement and laid under close laboratory supervision. You must remember that quality should be first consideration. The condition of the streets indicate the character of the city.

Wilmington, Del. Last of four 32-ton girders hauled on a 6-ton truck by 35 horses, November 28, 1911, over Bitulithic paving four years old at Fifth and Spruce Streets. These tremendous loads made not the slightest mark on the Bitulithic Pavement.

Stop and Consider—

BITULITHIC, before determining to use inferior street paving. It is cheaper to have a good pavement in the beginning than to contract for cheap construction which has to be repaired every year.

NO TIME LIKE THE PRESENT

to consider what construction you are going to use on your streets. Specify **BITULITHIC** and have a pavement which is unequalled in reputation—unquestioned in quality—unrivalled in popularity.

Don't wait—get your contracts in early for **BITULITHIC,** a pavement suitable under all the varying climatic conditions.

Write today for explanatory booklets and learn more about this modern pavement for modern cities.

Warren Brothers Company

EXECUTIVE OFFICES:
59 Temple Place, BOSTON, MASS.

DISTRICT OFFICES:

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50 Church St.	10 S. LaSalle St.	303 Main St., West.	926 Calif Bldg.	Journal Bldg.	204 Noll Bldg.

NASHVILLE, TENN.	RICHMOND, VA.	ST. LOUIS, MO.
606 First National Bank Bldg.	Virginia Railway & Power Bldg.	Railway Exchange Bldg.

Tennessee—
Brownsville: Water works plant, bond issue $12,000.
Jonesboro: Water works system.
Tiptonville: Water works system, cost $17,500.

Texas—
Aransas Pass: Water works and light plant, cost $30,000.
Rosenberg: Water works plant and distributing system at $18,000 and drainage system at $11,000.

Washington—
North Yakima: Water system, cost $15,000.
Pullman: Water works system improvement, cost $20,000.

West Virginia—
Wheeling: Rapid sand or mechanical filtration system, cost $240,000.

Wisconsin—
Two Rivers: Intake into Lake Michigan, cost $40,000.

BRIDGES.

Alabama—
Birmingham: Reinforced concrete bridge, cost $6,000.

Arizona—
Wickenburg: Reinforced concrete bridge, cost $10,000.

Arkansas—
Murfreesboro: Five steel bridges in Pike county.
Newport: Reinforced concrete bridge.

California—
Butte City: Bridge across Sacramento river in city.
Fairfield: Ten concrete bridges and one subway for Solano county.
Fresno: Bridge across canal, cost $7,000.
Marysville: One concrete bridge, length 2,200 ft. and three concrete bridges, length 50-ft. in Yuba county.
Placerville: One single arch concrete bridge in Eldorado county.
Redding: One steel bridge, Shasta county.
Redwood City: One bridge.
Sacramento: Reinforced concrete and timber trestles in Yolo county; one steel draw-bridge over Sacramento river and five concrete arches over American river in Sacramento county.
San Luis Obispo: Four steel girder and 12 concrete bridges in county.
San Barbara: $75,000 to be expended this year.
Willows: Protection work at Orland bridge.
Yuba City: Concrete girder bridge on Colusa road, cost $60,000.

Colorado—
Boulder: Four concrete bridges in city.
Canon City: Reinforced concrete and steel viaduct, cost $27,000.
Ft. Morgan: Reinforced concrete bridge in county.

Connecticut—
Hartford: One stone arch bridge, cost $9,500 in city.

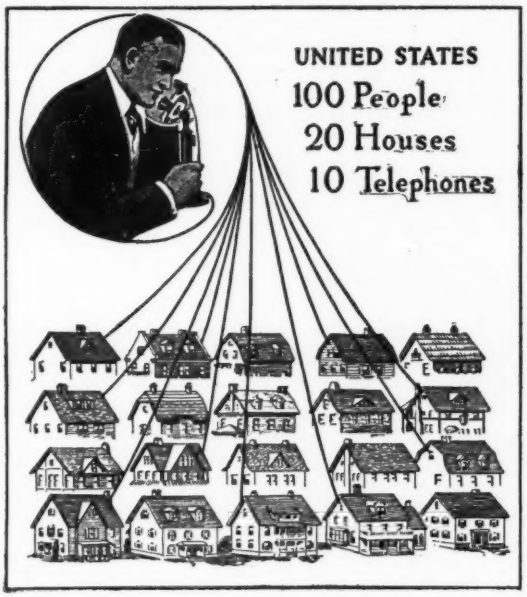
Florida—
Fernandina: One plate girder draw-bridge over Amelia river.
Jacksonville: Three concrete bridges in Duval.

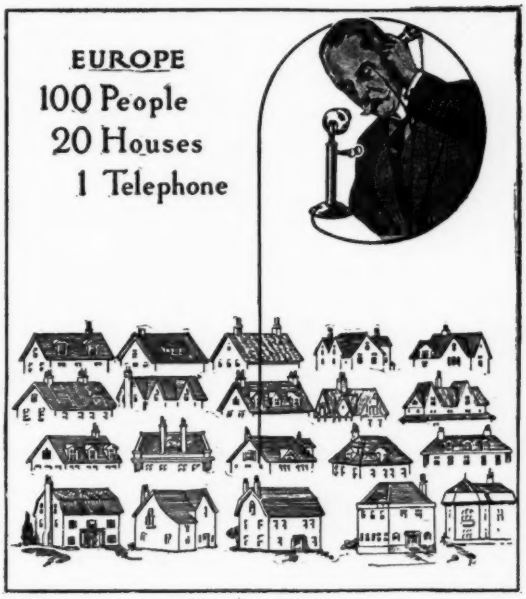
Georgia—
Covington: One steel bridge, length 300 ft., and one concrete arch bridge in city.

Illinois—
Bellevidere: Repairing State St. bridge.
Biggsville: One reinforced concrete bridge in Henderson county.
Cambridge: One reinforced concrete bridge in Henry county.
Chicago: One steel girder bridge, one swinging bridge and four bascule bridges.
El Paso: One reinforced concrete bridge in Woodford county.
Geneseo: Reinforced concrete bridge, span 60-ft., Henry county.
Grafton: Reinforced concrete bridge in Jersey county.
Harrison: Dobson bridge.
Herrick: Two reinforced concrete bridges in Macoupin county.
Momence: Bridge over Kankakee river.
Monticello: Bridge over Sangamon river, cost $7,000.
Pekin: One reinforced concrete bridge in Tazewell county.
Peoria: Approach to Kickapoo creek bridge.
Rockton: One reinforced concrete bridge.
Roscoe: One reinforced concrete bridge.
Springfield: Two bridges in Liberty Twp., Effingham county.
Stockton: Zink and Allison bridges.
Swansea: Reinforced concrete bridge, St. Clair Twp., St. Clair county.
Winchester: One reinforced concrete culvert in Scott county.

Indiana—
Anderson: Three bridges in Madison county.
Bloomfield: Bridge in Center Twp., Green county.
Bluffton: 18 bridges in Wells county.
Boonville: Eleven bridges in Warwick county.
Brownstown: Two steel bridges in Jackson county.
Connersville: Construction of four bridges and repair of two bridges.
Corydon: Bridge in Webster Twp., Harrison county.
Crown Point: Ten bridges in Lake county.
Greenfield: Bridge in Brown Twp., Hancock county.
Indianapolis: Several culverts and bridges in Marion county; bridge over White river at Washington St. in city, length 800 ft.; steel plate girder bridge over Pleasant Run at Minnesota St. in city.
LaGrange: Five steel and concrete girder bridges, LaGrange county.
LaPorte: Several bridges in LaPorte county.
Lebanon: Several bridges in Boone county.
Marion: Four bridges in Grant county.
Mishawaka: Steel and concrete br two 80-ft. arches and one 116-ft. arch over St. Joseph river in city.
Newcastle: Fourteen bridges, arches and repairs.
Peru: One bridge and repair of another in Miami county.
Portland: Twenty-four new bridges, nine repair jobs, and one stone wall.
Salem: Seven concrete bridges in Washington county.
Shelbyville: Several bridges and culverts in Shelby county.
Vernon: Concrete bridge across Big creek.
Vincennes: Four bridges.
Wabash: Bridge over Eel river in city.
Winamac: 18 bridges in Pulaski county.

Iowa—
Cedar Rapids: Paving of B Ave. bridge.
Davenport: Several steel and reinforced concrete bridges.
Dennison: 25 concrete and steel brid
Hampton: 20 highway bridges.
Knoxville: 90 reinforced concrete culverts and eight small steel bridges.





Results Compared with Theories

Here we have:

Ten telephones for each hundred persons.

Nearly one rural telephone to every two farms.

Reasonable rates fitted to the various needs of the whole people.

Telephone exchanges open continuously day and night.

Policy—prompt service.

There they have:

One telephone for each hundred persons.

Practically no telephones on the farms.

Unreasonable rates arbitrarily made without regard to various needs of the whole people.

Telephone exchanges closed during lunch hour, nights and Sundays.

Policy—when your turn comes.

America's Telephones Lead the World with the Best Service at the Lowest Cost.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy ***One System*** ***Universal Service***

Lake City: Bridge over Coon river near city.
Marshalltown: Two reinforced concrete bridges.
Mason City: 14 concrete bridges.
Oskaloosa: 16 bridges.
Sioux City: 31 county bridges.
Tipton: One 70-ft. steel span; one concrete deck girder bridge, and several concrete box culverts.

Kansas—
Emporia: One steel girder bridge, five concrete arch bridges, and 40 concrete bridges in Lyon county.
Marion: Nine bridges in Marion county.
Newton: Four concrete bridges in Harvey county.
Pittsburg: Six combination steel and concrete bridges in Crawford county.

Kentucky—
Henderson: Bridge over Highland creek in Henderson county.

Louisiana—
Lake Charles: Two swing bridges over Intercostal canal.
Plaquemine: Bridge at Indian Village.

Maine—
Foxcroft: One reinforced concrete bridge at Lincoln St.

Massachusetts—
Boston: Steel bridge at Granite Ave.
Maynard: Concrete bridge and retaining walls on Florida road.
Newburyport: Rebuilding Newburyport turnpike bridge.

Michigan—
Bay City: Five bridges in Bay county.
Grand Rapids: Bond issue $138,000 for Pearl St. bridge.
Lansing: Ten highway bridges.

Minnesota—
Bemidji: 33 steel bridges.
Luverne: Two bridges on State road No. 5.
New Ulm: Steel and concrete bridge in town of Stark.
Sartell: Reinforced concrete bridge over Mississippi river.

Mississippi—
Aberdeen: Steel span bridge on Okolona road.
Greenville: Bridge across Deer creek in Washington county.
Natchez: Nine steel bridges in Adams county.

Missouri—
Kansas City: Rebuilding viaduct at 19th St.; new viaduct at 23d St., and concrete girder bridge in county.

Montana—
Dillon: One steel bridge over Big Hole river.
Glasgow: One steel girder and four concrete bridges in Valley county.
Missoula: 80-ft. concrete arch bridge at Cedar St.

Nebraska—
Beaver City: Several steel bridges.
Cambridge: Reinforced concrete bridge, cost $18,000.
Clay Center: Six bridges in county.
Imperial: Several bridges in county.
North Platte: Concrete girder bridge across North Platte river, in Lincoln county.
Omaha: 240-ft. span bridge in Douglass county.
St. Paul: High truss core steel bridge across Middle Loop river in Howard county.

North Carolina—
Reidsville: County bridge over Dan river, cost $12,500.
Winston-Salem: Iron bridge over Yadkin river, cost $31,000.

New Jersey—
Burlington: Pearl St. bridge, cost $15,000.
Mt. Holly: Reinforced concrete arch bridge at Pearl St.

New York—
Albany: Crescent bridge over Mohawk river, cost $185,000; reinforced concrete highway bridge over Black river at Lyons Falls, Lewis county.
Fonda: Six concrete bridges and 100 culverts in Montgomery county.
Mt. Vernon: Bridge at Fulton Ave., cost $47,000.
Ogdensburg: One concrete steel arch bridge in city.
Silver Springs: Four reinforced concrete bridges in Janesville.
Yorkville: Half-way bridge.

Ohio—
Canton: Bridge across Ohio canal; concrete bridge across Black creek, 2 spans.
Cincinnati: Four concrete bridges and three reinforced concrete viaducts.
Columbus: Several reinforced concrete bridges in Franklin county.
Coshocton: Denham steel bridge, floor and tubular piers, cost $17,000.
Dayton: Six steel girder bridges, one concrete arch bridge, and several culverts.
Eaton: Superstructure of bridge across Browers Run.
Elyria: $1,500,000 to be expended on elevated tracks or roadways.
Hamilton: Bridge at High St. over Miami river.
Lorain: East 28th St. subway.
Piqua: Concrete bridge over Miami river at Union St., cost $98,000.
Steubenville: Protection wall on Mingo pike, and concrete abutment for bridge No. 23.
Tiffin: Three reinforced concrete bridges in city.
Troy: Ten steel girder and 25 concrete bridges in Lincoln county.
Zanesville: Suspension bridge at Dresden; and steel bridge over Muskingum river at 6th St.

Oklahoma—
Arnett: 22 concrete culverts in Ellis county.
Fairview: Six steel girder and two concrete bridges in Major county.
Hobart: Nine steel bridges, one concrete bridge in Kiowa county.
McAlester: One concrete bridge in city.

Oregon—
Oregon City: Steel bridge spanning Eagle creek, cost $5,000.
Portland: Bridges 3, 4, 5 and 6 on Columbia highway at $40,050, and bridges 1, 2, 7 and 8 at $37,000.

Pennsylvania—
Ebensburg: Three reinforced concrete bridges.
Ford City: Bridge to cost $24,000.
Harrisburg: Wasser bridge across Shenango river, Mercer county.
Hooversville: Three steel bridges in Somerset county.
Lock Haven: Concrete, slag or wood floo on bridge in Clinton county.
McKees Rock: Bridge No. 2 over Chartier creek.
Monessen: 24 concrete steel bridges in Rostraver Twp.
Phoenixville: Bridge across Schuylkill river.
Reading: Reinforced concrete between Amity and Union Twps.
Warren: Bridge across Allegheny river in city, cost $95,000.

South Carolina—
Marion: One steel girder and four co crete bridges in county.

Tennessee—
Memphis: Steel approaches to J. T. Harahan bridge at $500,000.

Leiman Bros. Rotary Positive

HIGH PRESSURE

BLOWERS

when used with gas or oil burning appliances maintain that high and steady heat so essential where brazing, forging, annealing, etc., are to be done properly and rapidly. They do this because all of the air capacity is utilized, the wings forcing the air along steadily, not in puffs or jumps—but steadily—thus doing the work right. That this is important is demonstrated by the fact that these machines are daily displacing machines of other makes in the laboratories and work-shops of the world's leading concerns in every line; also in the principal colleges and schools of the land.

When you buy a machine like ours you get one that will be doing as good work next year, the year after and for many another year because it is built scientifically and simply all in one. When you want efficiency in a blower you don't want slippage—look at the construction of these machines—you can doubtless understand at a glance how these machines can be effective. They rely on centrifugal force to keep the wings against the cylinder while in motion.

They take up their own wear. Can't get out of order.

They may also be used for

VACUUM CLEANING

or any other work requiring a pressure up to 10 pounds or vacuum up to 28 inches.

There are many uses for these machines in every laboratory or work-shop—from creating high heat with oil or gas, to cleaning and renewing the surface of blackboards—cleaning the shells of eggs without the use of water; milking cows without the use of the hand; testing of all kinds; cleaning rust and corrosion; and many other special uses. No matter what your problem is the use of air is liable to handle it to better advantage. Ask us.

LEIMAN BROS.

62AL John St. **NEW YORK.**

Blower Catalogue No. 100. **Vacuum Catalogue No. 101.**

Nashville: Reinforced concrete viaduct at Cleveland St.

Texas—
Amarillo: Steel bridge across Canadian river, cost $15,000.
Angleton: Steel draw span bridge over Bastrop Bayou.
Belton: Two steel bridges over Nolan creek in city.
Cameron: Port Sullivan and Wild Cat bridges.
Houston: Several county bridges.
San Antonio: 11 culverts and ten girder bridges reinforced concrete in county, and concrete bridge at Houston St. in city.
San Angelo: Approaches to Christoval bridge.
Seguin: One concrete bridge in county.
Smithville: An 807-ft. steel bridge.
Sommerville: A 700-ft. steel bridge in county.
Waco: Rebuilding suspension bridge, cost $52,000.
Wharton: Two bridges.

Utah—
Salt Lake City: Suspension bridge to span Grand River Dewey.

Virginia—
Fairfax: Three concrete bridges in county.
Marion: 115-ft. bridge in Smyth county.

Vermont—
Northfield: Reinforced concrete bridge in city.

Washington—
Bellingham: One pile trestle, length 624 ft.
Chehalis: Steel bridge at Riverside, cost $14,000.
Conconelly: Bridge across Okanogan river at Melot.
Everett: Two steel bridges and one concrete bridge in county.
Olympia: Five steel girder bridges in Thurston county.
Wenatchee: Two large concrete bridges in Chelan county.

West Virginia—
Clarksburg: Concrete bridge, length 580 ft. and one steel bridge 450-ft.
Proctor: Three concrete bridges in Wetzel county.

Wisconsin—
Green Bay: Bridge over Fox river at $152,000.
Janesville: Six concrete bridges and one steel girder bridge in Rock county.
Milwaukee: Bridge across Milwaukee river in city, bond issue $350,000.

Wyoming—
Sheridan: One steel reinforced concrete bridge over Little Goose creek in city.

LIGHTING.

Alabama—
Gadsden: Municipal light plant.

California—
Redlands: Two miles ornamental lighting.
Sacramento: Municipal light plant, cost $115,000.

Colorado—
Colorado Springes: Municipal light plant, bond issue $150,000.

Connecticut—
East Norwalk: Appropriation of $25,000 made for light plant.

Florida—
Jacksonville: Lamps for municipal light plant, number indefinite.

Idaho—
Boise: 232 cast iron poles and 232 luminous arc lamps.

Illinois—
Chicago: Light and power system in 22d St. pumping station and in Harrison St. pumping station; 1,000 ornamental incandescent gas mantle lamps on certain streets to be installed.
Elgin: Municipal light plant. Appropriation $162,000.
Sterling: Boulevard lighting system to be installed.
Ottawa: 168 arch lights.

Indiana—
Anderson: Lighting system on Main and Meridian Sts.
Ft. Wayne: Addition to municipal light plant.
Huntington: Rebuilding and enlarging present city light plant.
Lafayette: Installation of boulevard lights along Main St. levee.

Kansas—
Atchison: Installation of number of lights.
Pittsburg: Ornamental lighting system, cost $13,000.

Louisiana—
Eunice: Electric light plant.

Manitoba, Can.—
Shoal Lake: Electric light system.

Maryland—
Baltimore: $30,000 to be expended for installation of 500 additional "White Way" lamps.

Massachusetts—
Seekonk: $500 voted for installation of "White Way."

Michigan—
Lapeer: Municipal light plant.
Unionville: Electric light plant to cost $8,000.

Minnesota—
Virginia: Gas plant, cost $75,000.

Montana—
Great Falls: 50 5-cluster ornamental lighting posts.
Helena: 675 electroliers, series Tungsten and Nitrogen.

Missouri—
Bevier: Municipal light plant in Callao.
Hale: Electric light plant in connection with ice plant.

North Carolina—
High Point: Arc light system.

New York—
Spencerport: $16,000 voted for electric light system.
Warsaw: Lighting in business section.

Ohio—
Painesville: $5,000 voted for lighting improvement.

Pennsylvania—
Butler: 175 three and five clusters of ornamental lights. 190-200 c. p. gas Tungsten lamps, and 310 80-c. p. Tungsten lamps.

Texas—
Austin: 100 cast iron poles and 100 series Tungsten lamps.
Houston: Municipal light and power plant.

Virginia—
Kenbridge: Electric light plant.

Wisconsin—
Juneau: $9,000 voted for electric light transmission line and distributing system.

AUTOMOBILES—FIRE APPARATUS.

Alabama—
Montgomery: Patrol wagon.

California—
Redlands: 80 h. p. 6-cylinder combination truck.
San Francisco: Appropriation of $450,000 recommended for motor vehicles.

What Do You Pay

Per Mile Per Year

BEVERLEY FARMS, MASSACHUSETTS.

to prevent dust and wear on unpaved streets and roads? If you are paying over 3½ cents per yard per year you will save money by using

SOLVAY Granulated Calcium Chloride

The perfect, natural water bond. There is practically no depreciation of well built roads, kept with Solvay Granulated Calcium Chloride. The effect of this natural binder is cumulative. Less chemical is required each year and the roads continually improve.

Solvay Granulated Calcium Chloride has no objectionable features. It is odorless, non-corrosive and will not stain. The experiences of hundreds of municipalities during the past four years prove this efficient treatment

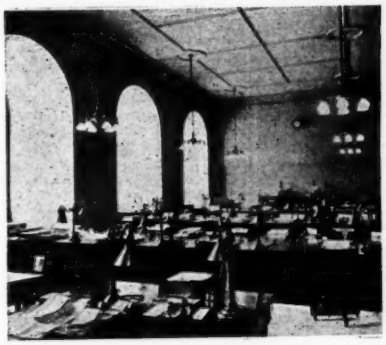
Least Expensive

Send for Illustrated Road Book

SEMET - SOLVAY CO. **Syracuse, N. Y.**

A Case of Defective Acoustics Corrected by the

J-M METHOD of Acoustical Treatment



Transcribing Room. Cuyahoga County Court House, Cleveland, Ohio.

The noise of twenty-five typewriting machines produced in this room so much reverberation that members of the office force were unable to do their work—some of them collapsing from nervous strain.

These distressing conditions were practically eliminated by the J-M Acoustical System.

Here is what Mr. Paul Schreiner, County Recorder, says in connection with this case:

"The work done by you is entirely satisfactory, and what is more, the appearance of the room remains about as it was. I desire to congratulate you upon having reduced to the minimum the noise and echo of the typewriting machines, thereby accomplishing what at one time seemed to be a hopeless task."

We are prepared to correct defective acoustics in court houses and municipal buildings of all types. Our methods are founded on a definite knowledge of scientific principles—not guess work. Positive results assured in every case.

No charge for preliminary recommendations. If you have an acoustical problem to solve write our nearest Branch for full particulars.

H. W. JOHNS-MANVILLE CO.

Albany	Chicago	Detroit	Louisville	New York	San Francisco
Baltimore	Cincinnati	Indianapolis	Milwaukee	Omaha	Seattle
Boston	Cleveland	Kansas City	Minneapolis	Philadelphia	St. Louis
Buffalo	Dallas	Los Angeles	New Orleans	Pittsburgh	Syracuse

THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED, Toronto, Montreal, Winnipeg, Vancouver. 2136

San Jose: One chemical wagon, two combination trucks, two horse-drawn patrol wagons, and one motor police patrol.
Watsonville: Auto fire apparatus recommended.

Connecticut—
Hartford: 5,000 ft. of hose, and $125.00 recommended for motor driven apparatus.
Willimantic: New hose.

Idaho—
Boise City: One combination chemical and hose wagon; one 4-wheel chassis combination wagon; one chassis for No. 1 steamer.

Illinois—
Bloomington: Auto patrol wagon.
Cairo: Auto for police department.
Chicago: 2-ton electric truck; two light automobile trucks; 5,000 ft. 1-in. chemical hose; and 50,000 ft. 2½-in. cotton rubber lined fire hose.
Joliet: Auto patrol; one combination chemical and hose; and one fire engine.
Moline: Bond issue $34,500 for motor apparatus.

Indiana—
Ft. Wayne: One motor truck power street flusher.
Logansport: One combination fire truck.
Vincennes: 500-ft. hose, and one automobile.

Iowa—
Cedar Rapids: Two 2-passenger autos for Department of Parks.
Clinton: Motor tractor for Central fire truck.
Dubuque: Triple combination motor pumping engine, and combination patrol and ambulance automobile.
Waterloo: One combination auto fire apparatus.

Kansas—
Ft. Scott: One patrol wagon motor-driven.
Topeka: Auto tractor for aerial truck.

Kentucky—
Clay: Chemical engine and other equipment.
Paducah: Triple combination automobile engine hose and ladder truck.

Louisiana—
Morgan City: Combination motor driven chemical and hose wagon, hook and ladder truck 1,000 ft. 2½-in. fire hose, and one 15-box alarm system.
Shreveport: Tractor.
Washington: 1,000 ft. 2½-in. 3-ply multiple woven fiber fire hose.

Maryland—
Baltimore: Rebuilding of fire engine No. 17.

Massachusetts—
Boston: Two 5-ton auto trucks for sanitary department.
Danvers: Purchase of additional fire equipment.
North Adams: Auto chemical and hose car.

Michigan—
Crystal Falls: One piece of motor fire apparatus.
Kinbe: Additional fire apparatus.

Minnesota—
Bemidji: 3-ton auto fire truck, cost $5,800.
Mankato: Fire hose.
St. Paul: 3,000 ft. hose, four chiefs' cars; one auto truck; four patrol wagons; one auto supply wagon; one auto for police department; two 5-ton auto trucks; one 4-passenger auto; and one 2-passenger auto for engineer's department.

Missouri—
Hannibal: One auto patrol wagon, and auto fire apparatus.

Mississippi—
McComb: Additional supply of hose and motor fire apparatus.

Montana—
Helena: One fire engine and one auto truck.

North Carolina—
Durham: Aerial truck; cost $10,000; motor police patrol, cost $3,000.

New Jersey—
Glen Ridge: Motor driven city service hook and ladder truck.
Newark: One fire engine.
Plainfield: Auto patrol and ambulance.
South Orange: Motor drawn apparatus.

New York—
Albany: Two-passenger runabout automobile for street department.
Bronx Borough: One 7½-ton motor dirven truck and two 5-ton motor driven fire trucks.
Cortland: Two piece or auto fire apparatus.
Dunkirk: Motor driven hose and chemical wagon.
Green Island: Fire alarm system to be installed, and 60-gal. chemical tank, shut-off nozzles, etc.
Jamestown: Combination pump chemical and hose car.
Johnstown: One combination auto chemical hose and ladder truck.
Manhattan Borough: Two touring cars for police department; seven motor-driven hose wagons, and three gasoline automobile ambulances for department of health.
Sodus: $1,000 voted for hose and hose carts.
Utica: 2,000 ft. fire hose; one combination hook and ladder truck.

Ohio—
Cincinnati: Motorization of entire fire department by equipping present steamer engines with tractors.
Chillicothe: One combination automobile pumping engine and hose wagon, and one combination hose and chemical wagon.
East Liverpool: Motor driven patrol wagon.
Girard: Motor truck for fire department.
Lima: One auto fire wagon.
Marion: 1,000 ft. 2½-in. fire hose.
Pioneer: Chemical engine.
Ulrichsville: Motor fire truck.
Steubenville: $5,500 issued for chemical automobile hose and fire truck.
Youngstown: Five passenger automobile for engineering department.

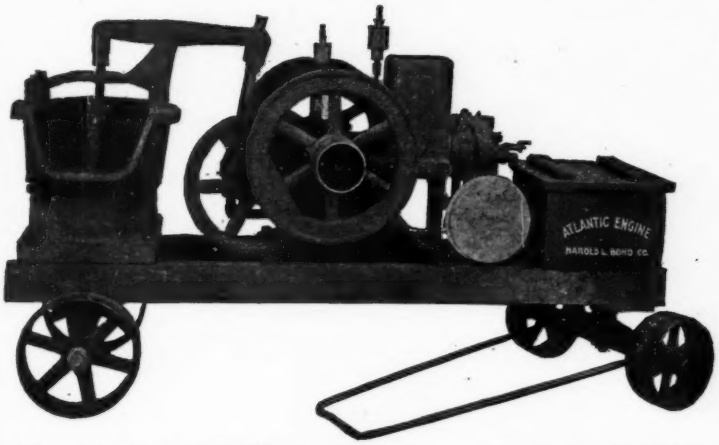
Oregon—
Portland: Auto truck, cost $3,000.

Pennsylvania—
Allentown: Three automobiles for fire department.
Butler: One patrol wagon and extension ladders.
Harrisburg: Combination chemical and hose wagon; one or more tractors for steam fire engines and 3,000 ft. fire hose.
Pittsburg: 10,000 ft. fire hose, and motor lawn mower.
Scranton: Two tractors for steam engines $7,000; three triple pieces, $21,000; two combination chemical, $10,000, and one aerial truck, $7,000.
Sharon: 950 ft. fire hose.
Wilkesbarre: Three tractors, and three auto combination wagons.
Williamsport: Triple combination motor pumping engine.

Puerto Rico—
San Juan: 1,000 ft. hose, new chemicals and electric signal system.

Quebec, Can.—
Montreal: One auto salvage wagon; four automobile tractors; two automobile hose

Making the Diaphragm Pump equal to the Engine!



New 4-inch Atlantic Diaphragm Trench Pump.

List Price, $165.00.

NEW POINTS:

A Special Top Head
Rigid Fulcrum
Positive Direct Piston Stroke

New Inlet Valve

Valve seat is machined, making a much more dependable closing of valve. Water inlet is changed in direction to decrease friction.

The Atlantic ENGINE remains the same, but the PUMP and connections with the engine are vastly improved; the pump has been made **equal to the engine** in efficiency.

The improvements shown, the extent of which every pump user will recognize at a glance, do three things:

First. They strengthen the pump materially.

Second. They eliminate lost motion by means of the positive piston stroke by giving full and regular length to stroke each time.

Third. They increase the flow of water and materially lengthen the life of the diaphragm.

OUR FREE TRIAL OFFER

We will send an ATLANTIC PUMPING ENGINE to any responsible party with the privilege of five days' trial. If it is not exactly as represented and superior to other equipment of the same kind, it may be returned to us and we will pay freight both ways.

Telegraph or write for net prices and full description.

HAROLD L. BOND COMPANY

383 M Atlantic Ave., BOSTON, MASS.

Manufacturers of

Ross Concrete Spade, Andrews' Concrete Tamper, Safety Trench Braces. Felton's Sewer and Concrete Rods, Pearl Brand Suction Hose.

wagons; one 85-ft. aerial ladder, automobile truck; and one auto fire engine.

Rhode Island—
Providence: Three fire trucks, cost $23,500.

Saskatchewan, Can.—
Moose Jaw: One motor truck; two motor combination hose and chemical wagons; one 75-ft. aerial truck; one motor triple combination; and one 2-wheel tractor.

Tennessee—
Knoxville: Auto police patrol.
Nashville: Auto engine for East End District and fire hose.

Texas—
Houston: One 3-ton motor driven truck for street department, one 5-ton m[illegible] combination street flushing and sprinkling machine; one 4-ton motor driven combination street flushing and sprinkling machine; one 3-ton motor driven combination street flushing machine; one auto ambulance. For Precinct No. 1, Harris county, one automobile.

Vermont—
Rutland: One chemical wagon.

Washington—
Hoquiam: 1,000 ft. 2½-in. hose, and 1,000 ft. 3-in. hose.
Port Angeles: 1,000 ft. 2½-in. fire hose.
Seattle: 8,000 ft. 2½-in. fire hose.
Spokane: One auto truck, and 2,000 ft. 2½-in. double-jacket rubber-lined fire hose.
Tacoma: $17,000 appropriated for apparatus.

Wisconsin—
Sheboygan: One combination auto patrol and ambulance.

West Virginia—
Wellsburg: Auto fire truck.

Wyoming—
Cheyenne: 1,000 ft. fire hose.

GARBAGE DISPOSAL.

Florida—
Pensacola: Crematory.
St. Petersburg: Garbage and refuse incinerator.

Illinois—
Cairo: Two garbage wagons or carts.
Chicago: 200 steel garbage boxes.
Joliet: Garbage crematory.

Indiana—
Logansport: Destructor plant.

Michigan—
Pontiac: Number of garbage cans and a reduction plant.

Missouri—
Hannibal: Four garbage wagons or carts.

New Jersey—
Plainfield: Garbage and refuse disposal system.

Ohio—
Marion: Garbage disposal plant.
Sandusky: Incinerating plant to cost $15,000.

Pennsylvania—
North Braddock: Two garbage wagons.
Reading: Reconstruction of two units of garbage disposal plant.

STREET SIGNS.

California—
Redlands: 200 enamel street signs.
Vallejo: 1,000 street signs.

Canada—
Winnipeg: Street name posts and name plates. Amount not specified.

Colorado—
Boulder: Metal street signs.

Illinois—
Chicago: 500 street sign posts on concrete foundations and name plates.
Peoria: 400 enamel steel plates.
East St. Louis: 1,900 street signs.
Waukegan: 400 street signs.

Indiana—
Logansport: 2,000 street signs and 3,000 house number plates.

New York—
Schenectady: About 50 sheet steel r signs in county.

North Carolina—
Charlotte: 1,012 blue enamel street signs.

Ohio—
Akron: 3,400 blue and white enamel street signs.
Sandusky: 4,000 metal street signs.

Oregon—
Portland: $5,000 to be expended on street signs.

West Virginia—
Proctor: 50 metal road signs for Wetzel county.

Wisconsin—
Wenatchee: Probably 100 plain painted road signs boards in Chelan county.

BUILDINGS.

Alabama—
Huntsville: City hall.

Arkansas—
Argenta: City hall, cost $75,000.
Hot Springs: Rebuilding Garland county court house, cost $35,000.

California—
Bakersfield: Remodeling court house, at $25,000; and constructing 2-story coun jail for Kern county.
Berkeley: Two-story fire station, cost $30,000.
Oakland: City hall, bond issue $32,000.
Oakland: Bond issue $500,000 for completion of municipal auditorium, and $80,000 for erection of Clawson school.
Richmond: City hall.
Santa Monica: Municipal auditorium, bond issue $150,000.

Florida—
Bartow: Jail for Polk county.
Jacksonville: Court house annex, cost $15,000.
Tampa: City hall, cost $183,000.

Illinois—
Chicago: Shelter houses for four playgrounds; two freight and passen[illegible] buildings for harbor district; 10-story and basement building in business district for police department; 21 police stations in outer districts.
Edwardsville: Court house, cost $193,000.
Olney: Court house, cost $70,000; township high school building.

Indiana—
Anderson: Remodeling city hall.
Bloomington: City hall, cost $25,000.
Bluffton: County hospital: cost $35,000.
Elkhart: City hall; school building for Noble county.
Indianapolis: Repairing shelter house in Riverside park.
Kendallville: City hall, cost $30,000.
Monon: Public library.

Iowa—
Pilot Mount: City hall, cost $5,000.
Rock Rapids: Court house.
Tama: City hall.

Kansas—
Horton: 2-story fire station.

Kentucky—
Paducah: Remodeling of court house.
Taylorsville: Court house, cost $30,000.